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Listing Background Document for the Chlorinated Aliphatics Listing Determination (Proposed Rule)

FINAL

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HAZARDOUS WASTE MINIMIZATION AND MANAGEMENT
DIVISION TECHNICAL SUPPORT CONTRACT

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1. INTRODUCTION

1.1 Background

The U.S. Environmental Protection Agency's (EPA's) Office of Solid Waste (OSW), as directed by Congress in the Hazardous and Solid Waste Amendments (HSWA) of 1984 to the Resource Conservation and Recovery Act (RCRA), has undertaken an investigation of the chlorinated aliphatics industry. This investigation was mandated by a 1994 consent decree resulting from litigation brought by the Environmental Defense Fund (EDF). The consent decree specifically requires listing determinations be made on "wastewaters and wastewater treatment sludges from the production of the chlorinated aliphatics specified in the F024 listing."

Under this consent decree, the Agency embarked on a multi-year project to determine whether these wastewaters and wastewater treatment sludges pose a threat to human health and the environment, and to develop a basis for making such a determination. This background document presents the information collected to support the listing determinations.

OSW studied the chlorinated aliphatics industry previously in the early 1980s. This industry study resulted in several hazardous waste listings, including F024, F025, and numerous K listings (see Section 1.2). The F024 listing, which covers a variety of process wastes from the manufacture of chlorinated aliphatics, specifically excludes the two waste streams addressed in this listing determination: wastewaters and wastewater treatment sludges (see Table 1-1). Spent catalyst wastes also are specifically excluded from the F024 definition and for a short period of time the Agency also initiated data collection efforts with respect to spent catalyst wastes. However, the Agency did not pursue listing determinations for spent catalyst wastes.

For the purposes of the current listing investigation, the Agency defined "chlorinated aliphatic" as it had previously in the F024 listing. Specifically, a chlorinated aliphatic is defined as any organic compound characterized by straight-chain, branched-chain, or cyclic hydrocarbons containing one to five carbons, with varying amounts and locations of chlorine substitution. Hydrocarbons are organic compounds composed solely of the atoms hydrogen and carbon. Aliphatics occur where the chemical bonding between carbon atoms are single, double, or triple covalent bonds (not aromatic bonds). Cyclic aliphatic hydrocarbons included in this class consist of alkanes, alkenes or alkadienes, and alkynes. For an aliphatic to be chlorinated, the hydrogen atoms in the "aliphatic hydrocarbon" have been chemically replaced with chlorine atoms, at different positions and also in multiple positions. It should be noted that while the F024 and F025 definitions are limited to wastes generated from the production of chlorinated aliphatics by free radical catalyzed processes, the Agency did not limit the current industry study to free radical catalyzed processes.

Chlorinated aliphatics products and intermediates reported (as of 1996) from facilities studied as part of this listing investigation include those involved in the manufacture of (CAS registry numbers are included in parenthesis):

- | | |
|--|------------------------------------|
| • allyl chloride (107-05-1) | • [REDACTED] |
| • chloromethane (74-87-3) | • [REDACTED] |
| • dichloromethane (75-09-2) | • 1,1,2-trichloroethane (79-00-5) |
| • chloroform (67-66-3) | • 1,1,1-trichloroethane (71-55-6) |
| • carbon tetrachloride (56-23-5) | • methallyl chloride (513-37-1) |
| • chloroprene (126-99-8) | • perchloroethylene (127-18-4) |
| • ethylene dichloride (EDC) (107-06-2) | • trichloroethylene (79-01-6) |
| • trans-1,2-dichloroethylene (156-60-5) | • chloroethane (75-00-3) |
| • 1,3-dichloropropene (542-75-6) | • vinylidene chloride (75-35-4) |
| • vinyl chloride monomer (VCM) (75-01-4) | • 3,4-dichloro-1-butene (760-23-6) |
| • hexachlorocyclopentadiene (77-47-4) | • 1,4-dichloro-2-butene (764-41-0) |
| • [REDACTED] | |

As part of the Agency's current investigation of residuals from chlorinated aliphatics, EPA conducted engineering site visits at manufacturing facilities to gain an understanding of the present state of the industry. The Agency collected familiarization samples to obtain data on the nature of the residuals of concern and to identify potential problems with respect to record sampling and analysis of the residuals of concern. Concurrently, the Agency developed, distributed, and evaluated a census survey of the industry. Science Applications International Corporation (SAIC) (EPA Contract No. 68-W4-0042) assisted EPA/OSW in an engineering review and subsequent entry of the questionnaire data into the Chlorinated Aliphatics Industry Studies Database (ISDB).

Due to budget constraints, the Agency suspended activity on the Chlorinated Aliphatics Listing Determination in late 1993, prior to collecting record samples. The listing determination process was resumed in May of 1996. Due to this lapse in the study, the Agency reevaluated the status of the industry via a questionnaire update request (1996 data) and various telephone conversations with facility contacts. Data from the questionnaire updates were incorporated into the Chlorinated Aliphatics ISDB. Utilizing the updated data, the Agency revised site selection and sample locations for the record sampling program and completed record sampling and analysis by the end of 1997.

1.2 Existing Chlorinated Aliphatics Listings

The Agency previously promulgated a series of listings that apply to the chlorinated aliphatics industry in previous investigations in the 1980s. These listing are associated both with general chlorinated aliphatics productions process and with the production of specific chlorinated aliphatic chemicals. In addition to the hazardous wastes shown in Table 1-1, there are a number of chlorinated aliphatics chemicals that are listed hazardous wastes when they are discarded, off-specification, container residues, or spills (U and P list wastes). Table 1-2 presents the Toxicity Characteristic (TC) hazardous wastes that also are chlorinated aliphatics.

Table 1-1. Existing Chlorinated Aliphatics Listed Hazardous Wastes

| Hazardous Waste Listing | Listing Description | Date of <u>FR</u> Publication |
|-------------------------|---|-------------------------------|
| F024 | Process wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor cleanout wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution. <i>[This listing does not include wastewaters, wastewater treatment sludges, spent catalysts, and wastes listed in 40 CFR 261.31 or 261.32.]</i> | 12/11/89 |
| F025 | Condensed light ends, spent filter and filter aids, and spent desiccant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution. | 12/11/89 |
| K016 | Heavy ends or distillation residues from the production of carbon tetrachloride | 11/12/80 |
| K018 | Heavy ends from the fractionation column in ethyl chlorine production. | 11/12/80 |
| K019 | Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production | 11/12/80 |
| K020 | heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production. | 11/12/80 |
| K028 | Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane. | 11/12/80 |
| K029 | Waste from the product steam stripper in the production of 1,1,1-trichloroethane. | 11/12/80 |
| K030 | Column bottoms of heavy ends from the combined production of trichloroethylene and perchloroethylene. | 11/12/80 |
| K095 | Distillation bottoms from the production of 1,1,1-trichloroethane. | 11/12/80 |
| K096 | Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane | 11/12/80 |

Table 1-2. Chlorinated Aliphatic Toxicity Characteristic (TC) Hazardous Wastes

| Hazardous Waste Listing | Listing Description | Date of <u>FR</u> Publication |
|-------------------------|----------------------|-------------------------------|
| D019 | Carbon Tetrachloride | 3/29/90 |

| Hazardous Waste Listing | Listing Description | Date of <u>FR</u> Publication |
|-------------------------|----------------------|-------------------------------|
| D022 | Chloroform | 3/29/90 |
| D028 | 1,2-Dichloroethane | 3/29/90 |
| D029 | 1,1-Dichloroethylene | 3/29/90 |
| D033 | Hexachlorobutadiene | 3/29/90 |
| D034 | Hexachloroethane | 3/29/90 |
| D039 | Tetrachloroethylene | 3/29/90 |
| D040 | Trichloroethylene | 3/29/90 |
| D043 | Vinyl chloride | 3/29/90 |

1.3 Other EPA Regulatory Programs Affecting The Chlorinated Aliphatics Industry

Each of EPA's major program offices has long-standing regulatory controls that apply to the chlorinated aliphatics industry. Some of the more significant programs with some relevance to this listing determination include the following:

- The Clean Air Act's National Emission Standards for Hazardous Air Pollutants (NESHAPs) for organic hazardous air pollutants from the synthetic organic chemical manufacturing industry at 40 CFR Part 63 include the following regulations:
 - ▶ Subpart F, which applies to any plant which produces ethylene dichloride (EDC) via oxychlorination, vinyl chloride monomer (VCM) by any process, or one or more polymers containing any fraction of polymerized VCM and limits the concentration of vinyl chloride to less than 10 ppm in process wastewaters and sets standards for emissions of VCM from a variety of fugitive emission sources.
 - ▶ Subpart G, which regulates process vents, storage vessels, transfer operations, and wastewater.
- The Clean Air Act's National Ambient Air Quality Standards (NAAQS), which prescribe limits for SO_x, CO, particulates, NO_x, and ozone.
- The Clean Water Act sets specific effluent guidelines for discharges to surface waters and POTWs for facilities in the organic chemical, plastic, and synthetic fibers sector, which includes manufacturers of chlorinated aliphatics.

- The Toxicity Characteristic, particularly for chlorinated aliphatic chemicals (e.g., vinyl chloride, D043), in combination with existing K and F hazardous waste listings applicable to chlorinated aliphatics (e.g., F024). There are existing land disposal restrictions (LDR) for such wastes.

EPA is presently pursuing regulatory approaches which may impact facilities manufacturing chlorinated aliphatics and generating K173-K175. These programs, obtained from the April 26, 1999 Unified Agenda (www.gpo.gov), are as follows:

- Land Disposal Restrictions; Potential Revisions for Mercury Listed and Characteristic Wastes: EPA will soon publish an Advance Notice of Proposed Rulemaking (ANPRM) to solicit data and comments on treatment data that the Agency has gathered on the treatment of mercury wastes. The data and information gathered by this ANPRM process are intended to be used to propose revised treatment standards for some forms of mercury hazardous wastes in a future rulemaking.
- NESHAP for Chlorine Production: EPA is evaluating emissions from facilities engaged in the production of chlorine and sodium hydroxide (caustic). Hazardous air pollutants emitted include chlorine, hydrogen chloride, and mercury. Some of these facilities may be co-located with chlorinated aliphatics producers.
- NSPS for Synthetic Organic Chemicals Manufacturing Industry: EPA proposed a rule (September 12, 1994) to develop a new source performance standard to control air emissions of volatile organic compounds from wastewater treatment operations of the synthetic chemical manufacturing industry. The rule is scheduled to be finalized in April 2000. Generators of K173 to K175 would likely be subject to this rule, and because it impacts wastewater treatment operations the quantities of K173 to K175 may be affected although the direction or magnitude of any change in waste quantities is difficult to predict.

It is difficult to determine the effect of these regulatory programs on the generation and management of K173-K175. Some of the regulatory programs underway may, in fact, have little to no effect on the generation rates and subsequent management of these wastes.

2. INDUSTRY DESCRIPTION

2.1 Chlorinated Aliphatics Industry Overview

2.1.1 Industry Study Profile

In 1992, the U.S. chlorinated aliphatics industry consisted of 27 facilities owned by 20 corporations. However, as a result of questionnaire updates in collected in 1997, the Agency learned that two chlorinated aliphatic facilities had closed, reducing the number of facilities to 25 and corporations to 19. Chlorinated aliphatics production facilities are located primarily in and around the petroleum industry along the Gulf Coast. Figure 2-1 illustrates the distribution of facilities across the country. The majority of these locations are fully integrated petrochemical processing facilities in which chlorinated aliphatic wastewaters are co-managed with non-chlorinated aliphatic wastewaters creating a co-mingled wastewater sludge. There are a number of facilities whose wastewater treatment systems manage only chlorinated aliphatics wastewaters; for the purpose of this listing determination these treatment systems, and resulting sludges, are termed “dedicated”.

Nearly 10 million metric tons of chlorinated aliphatics were reported to be produced in 1996 from 23 different chlorinated products and intermediates. (1996 data from the RCRA Section 3007 questionnaire¹). The production capacity for the three largest chlorinated aliphatics products and intermediates (EDC, VCM, and methyl chloride constitute the great majority of the total industry-wide production of chlorinated aliphatics) exceeds 20 million metric tons. (www.chemexpo.com, 1998). For the purposes of this industry study intermediate and product are defined in relation to the chlorinated aliphatics industry. A chlorinated aliphatic “intermediate” is a chemical which is produced and consumed on-site in a chlorinated aliphatic process, a chlorinated aliphatic “product” is a chemical which is either sold or shipped off site or is consumed on-site in a non-chlorinated aliphatic process (i.e., VCM consumed on-site in the manufacture of polyvinyl chloride is considered a product, while the EDC consumed during the manufacture of VCM is considered an intermediate). Of this total, greater than 85% was EDC/VCM manufactured via the balanced process (see Section 3.1.1). Chlorinated methanes and chloromethane production volumes accounted for 7% and 3%, respectively. The remaining volume is produced using nine other processes. Only five of the 25 facilities produce two or more chlorinated aliphatic products; the four largest facilities manufacture a majority of all chlorinated aliphatics by volume.

Tables 2.1 and 2.2 provide information on the types of products and manufacturing processes that are found in the U.S. chlorinated aliphatics industry. These manufacturing processes are discussed in greater detail in Section 3.

¹Facilities did not always provide production quantities, particularly for captively used intermediates (i.e., EDC consumed in the manufacture of VCM), hence this production number is lower than actual 1996 production.



Figure 2-1.

Geographical Distribution of Chlorinated Aliphatics Manufacturers

Geography

Table 2-1. Frequency of Manufacturing Processes within the Chlorinated Aliphatics Industry (1996 Data)

| Processes Generating EDF Consent Decree Wastes | Production Quantity (Mtons) | Market Share | # of Processes | # of Production Quantities Not Reported |
|--|-----------------------------|--------------|----------------|---|
| EDC and/or VCM, balanced process | 7,864,697 | 85.38% | 17 | 2 |
| Chlorinated Methanes | 687,735 | 7.47% | 4 | |
| Methyl Chloride | 270,300 | 2.93% | 3 | |
| Perc/Tri/Carbon Tet | | | | 1 |
| VCM (based on acetylene) | | | | |
| Chloroprene/Chlorinated butenes | | | | |
| Methyl chloroform (1,1,1-trichloroethane) | | | | 1 |
| VDCM (Vinylidene Chloride) | | | | 1 |
| Trichloroethylene | | | | |
| Hexachlorocyclopentadiene | | | | |
| Methallyl Chloride | | | | |
| Allyl Chloride | | | | |

Total: 9,211,614 Mtons

| Process Not Generating EDF Consent Decree Wastes | Production Quantity (Mtons) | Market Share | # of Processes | # of Production Quantities Not Reported |
|--|-----------------------------|--------------|----------------|---|
| Chloroethane | | | | 1 |
| <i>trans</i> -1,2-dichloroethylene | | | | 1 |
| Allyl Chloride | | | | 1 |
| 1,3-dichloropropane | | | | 1 |
| 1,1,2-trichloroethane | | | | 1 |
| Perc/Tri/Carbon Tetrachloride | | | | |

Total:

Table 2-2. Products/Processes at Chlorinated Aliphatics Facilities (1996 Data) that Generate Consent Decree Wastes

| Facility Name/Locations | Products Manufactured |
|---|--------------------------------------|
| Borden Chemicals and Plastics; Geismar, LA | EDC/VCM (balanced process) |
| | VCM (based on acetylene) |
| Condea Vista Company; Westlake, LA | EDC/VCM (balanced process) |
| Dow Chemical Company; Freeport, TX | Chlorinated Methanes |
| | EDC Only |
| | EDC/VCM (balanced process) |
| | Trichloroethylene |
| | VDCM (Vinylidene Chloride) |
| Dow Chemical Company; Plaquemine, LA | Chlorinated Methanes |
| | EDC/VCM (balanced process) |
| Dow Corning Corporation; Carrollton, KY | Chloromethane |
| Dow Corning Corporation; Midland, MI | Chloromethane |
| Du Pont-Dow Elastomers LLC; LaPlace, LA | Chloroprene |
| Du Pont-Dow Elastomers LLC.; Louisville, KY | |
| FMC Corporation; Baltimore, MD | Methallyl Chloride |
| Formosa Plastics Corp. USA; Baton Rouge, LA | EDC/VCM (balanced process) |
| Formosa Plastics Corp. USA; Point Comfort, TX | EDC/VCM (balanced process) |
| Ge Electric Corporation; Waterford, NY | Chloromethane |
| Georgia Gulf Corporation; Plaquemine, LA | EDC/VCM (balanced process) |
| Occidental Chemical Corp.; Convent, LA | EDC Only |
| Occidental Chemical Corp.; Deer Park, TX | EDC/VCM (balanced process) |
| Occidental Chemical Corp/Oxymar; Gregory, TX | EDC/VCM (balanced process), EDC Only |
| PPG Industries; Lake Charles, LA | EDC/VCM (balanced process), EDC Only |
| | MC (1,1,1-trichloroethane) |
| | Perc/Tri/Carbon Tet |
| | VDCM (Vinylidene Chloride) |
| Shell Oil Company; Norco, LA | Allyl Chloride |
| The Geon Company; LaPorte, TX | EDC/VCM (balanced process) |
| Velsicol Chemical Corporation; Memphis, TN | Hexachlorocyclopentadiene |
| Vulcan Chemicals Company; Wichita, KS | Chlorinated Methanes |
| Vulcan Materials Company; Geismar, LA | Chlorinated Methanes |
| | EDC Only |
| | MC (1,1,1-trichloroethane) |
| Westlake Monomers Corp.; Calvert City, KY | EDC/VCM (balanced process) |

2.1.2 Recent Developments

Since completion of the updated industry study for 1996, several developments in the chlorinated aliphatics industry have occurred. Limited information has become available that indicates that several facilities have either increased production capacity, others have shut down, and new facilities have opened. Most of this data was obtained from chemexpo.com.

Please note that recent information for all chlorinated aliphatic products and manufacturing facilities could not be collected in time for this background document. Only the available information is presented, and no attempt to integrate the information into the 1996 summary was made.

EDC/VCM

Since completion of the industry study and 1996 update, one new facility has begun production of EDC and VCM, and several facilities have expanded production capacity of EDC and VCM. Tables 2-3 and 2-4 present these capacities for EDC and VCM, respectively. PHH Monomers opened a EDC/VCM production unit in late 1996. (www.chemexpo.com, 1998)

Formosa has plans to add 290 million pounds of EDC at Point Comfort. Georgia Gulf added 400 million pounds of EDC capacity in 1996 at the Plaquemine site. PHH Monomers is a joint venture of PPG and Condea Vista. OxyMar is a joint venture of Occidental and Marubeni Corporation. (www.chemexpo.com, 1998)

Borden is planning on increasing their acetylene-based VCM production capacity by 250 million pounds per year by the end of 1997. Georgia Gulf added 350 million pounds of capacity in 1996 at the Plaquemine facility. OxyMar completed expansion to increase their capacity to 2.1 billion pounds in July 1997. PHH Monomers (joint venture between PPG and Condea Vista) opened a 500 million pound unit at Lake Charles in 1996. Shintech is planning on opening a facility with a production capacity of 500,000 metric tons for VCM. (www.chemexpo.com, 1998)

Table 2-3. EDC Production Capacity

| Facility Name | EDC Capacity (million lbs/yr) |
|--|-------------------------------|
| Borden; Geismar, LA | 745 |
| Condea Vista Company; Westlake, LA (formerly Vista Chemical) | 1,400 |
| Dow, Freeport, TX | 4,500 |
| Dow, Plaquemine, LA | 2,300 |
| Formosa, Baton Rouge, LA | 525 |
| Formosa, Point Comfort, TX | 1,900 |
| Georgia Gulf, Plaquemine, LA | 1,760 |
| OxyChem, Deer Park, TX | 1,950 |
| OxyChem, Convent, LA | 1,500 |
| OxyChem, Ingleside (Gregory), TX | 1,500 |
| OxyMar, Ingleside (Gregory), TX | 3,000 |
| PHH Monomers, Lake Charles, LA | 1,400 |
| PPG, Lake Charles, LA | 1,600 |
| Geon, LaPorte, TX | 4,000 |
| Vulcan Materials Company; Geismar, LA | 500 |
| Westlake Monomers Corp.; Calvert City, KY | 1,950 |

(Source: www.chemexpo.com, 1998)

Table 2-4. VCM Production Capacity

| Facility Name | VCM Capacity (million lbs/yr) |
|--|-------------------------------|
| Borden; Geismar, LA | 950 |
| Condea Vista Company; Westlake, LA (formerly Vista Chemical) | 850 |
| Dow, Plaquemine, LA | 1,500 |
| Dow, Freeport, TX | 2,200 |
| Formosa, Baton Rouge, LA | 1,455 |
| Formosa, Point Comfort, TX | 875 |
| Geon, LaPorte, TX | 1,650 |
| Georgia Gulf, Plaquemine, LA | 1,600 |
| OxyChem, Deer Park, TX | 1,100 |
| OxyMar, Ingleside (Gregory), TX | 2,100 |
| PHH Monomers, Lake Charles, LA | 1,150 |
| Westlake Monomers Corp.; Calvert City, KY | 1,200 |

(Source: www.chemexpo.com, 1998)

Methyl Chloride, Methylene Chloride, Chloroform

LCP Chemicals, Occidental, and Vista (now Condea Vista) closed methyl chloride facilities with a combined capacity of 175 million pounds during 1991 and 1994. Dow and Vulcan captively use a significant portion of their methyl chloride production to manufacture other chloromethanes. GE Plastics and Dow Corning use all their methyl chloride production captively for silicones manufacture. LCP Chemicals and Occidental Chemical closed facilities with methylene chloride and chloroform capacities totaling 170 and 116 million pounds per year, respectively, between 1991 and 1994. Vulcan has expanded production of methyl chloride, methylene chloride, and chloroform its Geismar and Wichita facilities since 1991.

Table 2-5. Methyl Chloride Production Capacity (million lbs/yr)

| Facility Name | Methyl Chloride | Methylene Chloride | Chloroform |
|----------------------------|-----------------|--------------------|------------|
| Dow, Freeport, TX | 55 | 125 | 200 |
| Dow, Plaquemine, LA | 175 | 125 | 200 |
| Dow Corning, Carrolton KY | 250 | | |
| Dow Corning, Midland, MI | 50 | | |
| GE Plastics, Waterford, NY | 100 | | |
| Vulcan, Geismar, LA | 90 | 80 | 160 |
| Vulcan, Wichita, KS | 70 | 100 | 160 |

(Source: www.chemexpo.com, 1997)

Perchloroethylene

Most perchloroethylene (tetrachloroethylene) has traditionally be co-produced with carbon tetrachloride by chlorination of propylene. However with the phase out of CFC-11 and 12, which made up virtually all of carbon tetrachloride's commercial use, chlorinated solvent manufacturers have modified their processes to produce perchloroethylene while minimizing or eliminating carbon tetrachloride. Occidental Chemical and Dow shut down perchloroethylene facilities with a total capacity of 230 million pounds in the early 1990s, and Vulcan closed a 25-million pound plant at Wichita in late 1996.

Table 2-6. Perchloroethylene Production Capacity

| Facility Name | Perchloroethylene Capacity (million lbs/yr) |
|-----------------------|--|
| Dow, Plaquemine, LA | 90 |
| PPG, Lake Charles, LA | 125 |
| Vulcan, Geismar, LA | 140 |

(Source: www.chemexpo.com, 1997)

Trichloroethylene

Trichloroethylene can be produced by chlorination of ethylene or EDC. Dow is scheduled to complete an expansion in 1998 to raise capacity and improve efficiency of its trichloroethylene plant in Freeport, TX. Use of trichloroethylene in fluorocarbon production and as a metal cleaning and degreasing solvent are increasing. TCE has gained some market share in vapor degreasing as a result of the phaseout of 1,1,1-trichloroethane for emissive uses. Growth as a fluorocarbon feedstock has more potential as TCE is a precursor for HFC-134a.

Table 2-7. VCM Production Capacity

| Facility Name | EDC Capacity (million lbs/yr) |
|-----------------------|-------------------------------|
| Dow, Freeport, TX | 120 |
| PPG, Lake Charles, LA | 200 |

(Source: www.chemexpo.com, 1997)

2.2 Industry Study

OSW's current listing determination for the chlorinated aliphatics industry has been underway since 1992 and consisted of two major avenues for information collection: field work and industry survey. As part of the field work component, the Agency conducted engineering site visits, familiarization sampling, and record sampling. The survey effort included the development, distribution, and assessment of an extensive industry-wide RCRA Section 3007 survey. Each of these elements is described further below, reflecting the relative order in which the Agency conducted these activities over the past 7 years.

2.2.1 Engineering Site Visits

EPA initiated field activities with a series of engineering site visits. The primary purpose of the site visits was to gather first-hand information about manufacturing processes, as well as waste generation, management, and characterization data for each of the two consent decree wastes. In addition, the goals of each engineering site visit included:

- 1) familiarizing industry with the goals and scope of this listing determination as well as the general steps that EPA will follow in making a determination,
- 2) clarifying information provided in the RCRA Section 3007 Questionnaire,
- 3) acquiring any additional information not supplied in the questionnaire regarding waste minimization activities, as well as information valuable to supporting risk assessment determinations, and
- 4) determining which wastes of interest are generated at the facility, their location, and other information vital to potentially sampling these wastes.

After considering logistical and budgetary constraints, the Agency selected 16 facilities for site visits prior to record sampling. These facilities were selected in order to obtain the most representative sampling of all chlorinated aliphatics processes, and to examine dedicated wastewater treatment units, when possible. The selected facilities are presented in Table 2-3.

Table 2-8. Engineering Site Visits Conducted

| Facility/Location | Site Visit Date |
|--|-----------------|
| Dow Chemical; Freeport, TX | 2/23/93 |
| Occidental Chemical; Deer Park, TX | 2/24/93 |
| PPG Industries; Lake Charles, LA | 2/25/93 |
| Occidental Chemical; Convent, LA | 3/16/93 |
| Formosa Plastics; Baton Rouge, LA | 3/17/93 |
| Vulcan Chemical; Geismar, LA | 3/18/93 |
| Georgia Gulf; Plaquemine, LA | 4/6/93 |
| Shell Chemical; Norco, LA | 4/7/93 |
| Dupont-Dow Elastomers; LaPlace, LA | 4/8/93 |
| The Geon Company (formerly B.F. Goodrich); LaPorte, TX | 5/11/93 |
| Borden Chemicals and Plastics; Geismar, LA | 5/12/93 |
| Occidental Chemical; Belle, WV | 6/8/93 |
| Velsicol Chemical; Memphis, TN | 6/9/93 |
| Dow Corning; Carrollton, KY | 6/15/93 |
| Dupont-Dow Elastomers; Louisville, KY | 6/16/93 |
| FMC Corporation; Baltimore, MD | 6/29/93 |

The Agency developed an engineering site visit report for each of the trips. The site visit reports include the following elements:

- Purpose of Site Visit
- Regulatory and Legal Basis for a Listing Determination
- Chlorinated Aliphatics Process Chemistry
- Process Descriptions
- Waste Streams and Waste Management Practices
- Familiarization Sampling Activities
- Site Visit Chronology

•
These reports are available in the rulemaking docket.

2.2.2 RCRA Section 3007 Questionnaires

EPA developed an extensive questionnaire under the authority of Section 3007 of RCRA for distribution to the chlorinated aliphatics manufacturing industry (a blank copy is provided as Appendix A). The purpose of the RCRA Section 3007 Questionnaire was to gather information about solid and hazardous waste management practices in the U.S. chlorinated aliphatics manufacturing industry. The Agency used this information to determine whether certain waste streams should be managed as hazardous under RCRA and added to the list of hazardous wastes under 40 CFR 261. The questionnaire included sections requesting information with respect to:

- Corporate and facility information
- Types of chlorinated aliphatic products and chlorinated aliphatic intermediates manufactured at the facility
- Types of processes at the facility
- Solvent use during the manufacturing process²
- Specific manufacturing processes; as well as residuals generated
- Residuals characterization
- General residual management information
- Specific on-site residual management information
- Source reduction efforts
- Signed certification

EPA distributed the survey in November of 1992 to 57 facilities and/or corporations identified as potential manufacturers of chlorinated aliphatic chemicals. The Agency extracted this list of facilities from the most recent information available at the time. Information resources included, but were not limited to:

- Documents and reports generated from previous listing determinations for the chlorinated aliphatics industry (F024/F025 and the numerous K listings)
- Toxic Release Inventory (TRI) data
- United States International Trade Commission's (USITC) *Synthetic Organic Chemicals* reports
- SRI's *Directory of Chemical Producers*
- Conversations with the Halogenated Solvents Industry Alliance (HSIA) Division of the Chlorine Institute
- Conversations and telephone calls with industry representatives.

²Information regarding solvents usage requested to support the concurrent spent solvents industry study.

Of the 57 surveys distributed, industry returned 28 surveys reporting that they had manufactured chlorinated aliphatics in 1991. These 28 questionnaires belonged to 27 facilities representing 20 companies³.

SAIC engineers reviewed the completed surveys for completeness and entered the data into a relational data base. SAIC subjected the entries in the data base to a series of quality assurance reviews to identify inappropriate entries and missing data links. In addition, SAIC conducted an exhaustive engineering review of each facility's response, resulting in follow-up letters and/or telephone calls to facility representatives seeking clarifications, corrections, and additional data where needed. The responses to these requests for clarification, along with additional information gathered during engineering site visits and familiarization and record sampling activities were integrated into the data base.

As noted in Section 1.1, EPA suspended activity on this listing determination project for two and a half years between the fall of 1993 and spring of 1996. Upon resuming the listing determination activities in 1996, the Agency initiated a review of data collected prior to the work stoppage. EPA contacted facility representatives to gather information regarding the current status of chlorinated aliphatics manufacturing operations. Ultimately, in June of 1997 the Agency sent requests for updated data (for calendar year 1996) regarding consent decree wastes generated by each facility. SAIC processed the data received from this request in the same manner as the original RCRA surveys, and entered into the data base. During the work stoppage, two chlorinated aliphatics manufacturers ceased operations, leaving a total of 25 chlorinated aliphatics manufacturing facilities associated with 19 different companies or corporations.

Each of the 25 facilities generated at least one consent decree waste: all 25 facilities generate wastewater, while 16 reported generation of wastewater treatment sludges.

2.2.3 Familiarization Sampling

As part of the analytical phase of the listing determination, the Agency developed a Quality Assurance Project Plan (QAPP) for sampling and analysis activities, followed by collection of 15 "familiarization" samples from three different manufacturing facilities. The agency collected samples of both consent decree wastes (wastewaters and wastewater treatment sludges), as well as QA/QC blanks and a single spent catalyst sample. The Agency collected these samples to assess the effectiveness of the laboratory analytical methods identified in the QAPP for the analysis of the actual residuals of concern. Table 2-4 provides a summary of the familiarization samples collected.

³Occidental Chemical Corp., located in Gregory, TX, submitted two separate questionnaires, one for each of two manufacturing processes on-site. One of these manufacturing processes is wholly owned by Occidental while the second is owned by OxyMar, Inc., a joint venture between Occidental and Marubeni.

The results of the familiarization sampling effort essentially confirmed the techniques identified in the QAPP and indicated that the laboratory generally would be able to achieve adequate quantitation of target analytes to support the listing determination. The QAPP is provided in the docket to this rulemaking.

It should be noted that following completion of the familiarization sampling and prior to initiating record sampling the Agency decided it was necessary to augment the sampling program outlined in the familiarization QAPP with dioxin/furan analyses for both the aqueous liquid and solid/sludge matrices. This change is incorporated into the final record sampling QAPP. Wastewater and wastewater treatment sludge samples collected during the first record sampling visit were treated as familiarization samples for the dioxin/furan analyses. However, our contracted laboratories did not encounter analytical difficulties during these analyses and these samples were deemed appropriate for use as record samples.

Table 2-9. Familiarization Samples Taken

| Site Name | Sample Date | Sample Number | Sample Name |
|---|-------------|---------------|--|
| Georgia Gulf Corporation; Plaquemine, LA | 4/6/93 | GG-01 | Wastewater from EDC phase separator (includes wastewater from EDC caustic treatment and drying stills) |
| | | GG-02 | Steam stripper effluent bottoms |
| | | GG-03 | Drainage wastewater from rainwater/pad areas prior to steam stripping |
| | | GG-04 | Spent catalyst from oxyhydrochlorination reactor |
| | | GG-05 | Equipment Blank |
| | | GG-06 | Dewatered wastewater treatment sludge from pile |
| Shell Chemical; Norco, LA | 4/7/93 | SH-01 | Equipment Blank |
| | | SH-02 | Caustic scrubber wastewater from HCl storage tank vent scrubber |
| | | SH-03 | Wastewater from HCl storage tank vent scrubber |
| | | SH-04 | Dewatered wastewater treatment sludge from belt press |
| DuPont-Dow Elastomers; LaPlace, LA | 4/8/93 | DP-01 | Scrubber wastewater from dichlorobutadiene synthesis |
| | | DP-02 | Combined wastewater from refining and scrubber wastewater |
| | | DP-03 | Scrubber wastewater from dichlorobutadiene isomerization unit |
| | | DP-04 | Brine wastewater from chloroprene production |
| | | DP-05 | Scrubber wastewater from incinerator |

2.2.4 Record Sampling

Prior to the work stoppage in September, 1993, the Agency had finalized a record sampling strategy and selection of facilities. However, the Agency based this sampling strategy, in part, on selection of spent catalyst waste streams - wastes that are no longer under consideration. In addition, 1996 industry data was available for use in the selection strategy. As a result, the Agency revised the sampling strategy.

Given budgetary constraints and the diversity of the chlorinated aliphatics industry beyond the EDC/VCM manufacturers, the Agency made every attempt to formulate a record sampling selection strategy which would ensure representativeness of the industry as a whole. The remainder of this section describes the rationale employed to identify 1) candidate facilities for record sampling and 2) individual waste samples.

1) Facility Selection: The Agency evaluated the following issues in selecting chlorinated aliphatics facilities for record sampling:

- a) What type of products are manufactured at the facility?** The Agency made every attempt to make the record sampling program representative of the entire chlorinated aliphatics manufacturing industry. To ensure sufficient coverage of the industry, each production process at a facility and its relative prevalence in the industry was taken into account.
- b) Does the facility generate wastes of concern?** Even though a facility might manufacture a chlorinated aliphatic product of interest, the manufacturing process may not generate either wastewaters or wastewater treatment sludges. The Agency considered all facilities with production processes generating wastewaters or wastewater treatment sludges.
- c) Does the facility have a dedicated wastewater treatment facility?** The Agency targeted facilities with dedicated wastewater treatment systems over facilities with treatment systems co-managing non-chlorinated aliphatic wastewaters because these samples are representative solely of chlorinated aliphatic processes.
- d) Has an engineering site visit been conducted at the facility?** The Agency gave priority to facilities that had been selected for a prior engineering site visit. Additional information regarding sampling locations and process chemistry and engineering was available for these facilities, simplifying sample collection.
- e) What is the geographic location of the facility?** Due to budget constraints, additional consideration was given to facilities conveniently located to those facilities already chosen for sampling.

2) Sample Selection: In conjunction with the facility selection process, the Agency evaluated specific sample points. The selection of possible individual waste streams from targeted facilities was based on the following criteria:

a) Is a wastewater or wastewater treatment sludge generated? The only wastes streams collected were consent decree wastes (wastewaters and wastewater treatment sludges).

b) Is the sample location representative of the actual waste entering a risk management unit? As record sampling data ultimately was used as an input into risk assessment modeling, it was important to ensure that the samples collected were representative of the wastes that actually enter waste management units. Ideally, wastewater samples will be combined influents (referred to as “headworks”) to the wastewater treatment system, while sludges will be sampled after dewatering operations prior to on- or offsite management.

c) Is the waste stream generated solely from chlorinated aliphatic processes? Many wastewaters in the industry are commingled with wastewaters from non-chlorinated aliphatic manufacturing processes. In these cases, wastewater treatment sludges generated from the treatment of these commingled wastewaters (also referred to as non-dedicated headworks) are also considered commingled or non-dedicated. As a result, collecting wastewater treatment sludges samples from dedicated wastewater treatment systems was a priority. Similarly, the first choice in sampling wastewaters was at the headworks of dedicated wastewater treatment systems. At facilities which did not have dedicated wastewater treatment systems, the Agency collected chlorinated aliphatic wastewaters prior to commingling (*i.e.*, at point of generation within the chlorinated aliphatic process), in addition to after commingling (*i.e.*, at the headworks) such that contaminants may be attributed to chlorinated aliphatics processes, if necessary.

d) Is the waste available for sampling? Certain waste streams are generated only periodically. For these waste streams, sample collection was not always possible. Facility personnel were asked when these wastes were expected to be generated, and attempts were made to sample such wastes.

e) Are there physical limitations to sampling the waste stream? During discussions with facility personnel and during engineering site visits every effort was made to identify specific sampling locations for each potential waste stream. Physical limitations such as piping configurations or extreme temperatures of the waste stream occasionally altered the point of collection.

The Agency initially targeted additional wastewaters and wastewater treatment sludges. However, due to additional factors such as process upsets, unscheduled process changes, and

other operational issues, some samples were not collected because it was determined that the sample would not be representative of wastes generated during “typical” process operations.

Upon completion of the familiarization sampling and analysis effort, the Agency initiated record sampling and analysis of the two consent decree wastes. The Agency sampled wastewaters and wastewater treatment sludges from twelve facilities. The Agency collected 52 samples (41 wastewaters and 11 wastewater treatment sludges), in addition to three Trip Blanks for Volatile Organics and two Field Equipment Rinse Blanks that were analyzed for the same constituents as the record samples. Additional sample volume was collected for five wastewater and wastewater treatment sludges to allow the laboratory to perform matrix spike/matrix spike duplicate (MS/MSD) quality assurance analyses for the aqueous, sludge, and TCLP matrixes. All record samples were collected during a four month period beginning in April 1997 and ending in July 1997. A complete sample-by-sample summary of the Agency’s characterization of these samples is provided in Appendix B and a comparison of this data to split samples voluntarily submitted by industry is provided in Appendix C.

Table 2-10 presents a summary of the record sampling program and describes the coverage of the chlorinated aliphatics industry attained by the program. Additionally, Table 2-11 provides a summary of each record sampling facility selected, date of sampling, and descriptions of the samples collected.

Despite the efforts made, the record sampling program was unable to completely cover the entire industry. Consent decree waste streams were not sampled from the manufacture of methallyl chloride (occurs at one location - FMC Corporation, Baltimore, MD). However, this manufacturing process accounts for less than [REDACTED] of the total industry-wide production volume in 1996. Additionally, samples were not collected from Aldrich Chemical (Milwaukee, WI), as they manufacture less than 100 lbs, annually, of specialty chlorinated aliphatics compounds. Neither of these two facilities generate wastewater treatment sludges; wastewaters are discharged to a POTW following pretreatment at both facilities.

Table 2-10. Representativeness of the Record Sampling Program

| Summary of Consent Decree Wastes Sampled | |
|---|---|
| Wastewaters sampled at 12 of 25 facilities generating wastewaters - headworks sampled at 5 of 7 facilities with dedicated wastewater treatment systems (7 of 9 systems) - 26% of the industry-wide wastewater quantity was sampled | |
| Wastewater treatment sludges sampled at 8 of 17 facilities generating wastewater treatment sludges - dedicated sludges sampled at 4 of 7 facilities with dedicated wastewater treatment systems (6 of 9 systems - one additional system sampled, however no sludge was being generated at time of sampling) - 85% of the industry-wide sludge quantity was sampled (90% of non-hazardous sludges sampled) | |
| Manufacturing Process | Number of wastewater treatment facilities sampled |
| EDC/VCM | 8 of 13 (62%) |
| Methyl Chloride | 1 of 3 (33%) |
| VCM (using acetylene as a feedstock) | 1 of 1 (100%) |
| Allyl Chloride | 1 of 1 (100 %) |
| Other chlorinated aliphatic processes sampled: - chloroprene - XXXXXXXXXX - hexachlorocyclopentadiene - incinerator water treatment (EDC/VCM facility) | 4 of 11 (36%) |
| Industry-wide Total: | 15 of 29 (54%) |

In addition, the Agency did not collect samples from the following manufacturing processes, as they were not reported to generate either wastewaters or wastewater treatment sludges:

- chloroethane (PPG Industries; Lake Charles, LA)
- trans-1,2-dichloroethane (PPG Industries; Lake Charles, LA)
- allyl chloride (Dow Chemical; Freeport, TX)
- 1,3-dichloropropene (Dow Chemical; Freeport, TX)
- 1,1,2-trichloroethane (Dow Chemical; Freeport, TX)
- perchloroethylene/trichloroethylene/carbon tetrachloride (Dow Chemical; Plaquemine, LA)
- perchloroethylene/trichloroethylene/carbon tetrachloride (Vulcan Materials; Geismar, LA)

Table 2-11. Samples Collected for Record Analysis⁴

| Site Name | Sample Date | Sample Number | Sample Name |
|--|-------------|---------------|--|
| Occidental; Gregory, TX ⁵ | 4/22/97 | OG-01 | EDC/VCM Wastewater Stripper Bottoms |
| | | OG-02 | Rock Box Effluent |
| | | OG-03 | EDC Wastewater Stripper Bottoms to WWTS |
| | | OG-04 | EDC/VCM WWT Sludge from Filter Press |
| | | OG-05 | Limestone Neutralization Sludge |
| | | OG-06 | EDC WWT Sludge from Filter Press |
| Velsicol; Memphis, TN | 5/20/97 | VT-01 | Combined Caustic Scrubber Waters (Prior to Carbon Treatment) |
| | | VT-02 | Caustic Scrubber Water from Incineration |
| | | VT-03 | Quench Water from Incineration |
| | | VT-04 | Combined Headworks to Pre-treatment |
| Dow Corning; Carrollton, KY | 5/21/97 | DC-01 | WWT Sludge |
| | | DC-02 | Waste HCL from Production Line #1 |
| | | DC-03 | Spent Scrubber Water from Production Line #1 |
| | | DC-04 | Waste HCL from Production Line #2 |
| | | DC-05 | Headworks to the WWTS Following Equalization |
| DuPont Dow Elastomers; Louisville, KY | 5/22/97 | DK-01 | Scrubber Water from DC Process |
| | | DK-02 | Scrubber Water from TCB Process |
| | | DK-03 | Wastewater from DCD Process |
| | | DK-04 | Combined WW Headworks to WWT |
| Borden Chemicals and Plastics; Geismar, LA | 6/4/97 | BG-01 | Combined Steam Stripper Bottoms from VCM-E |
| | | BG-02 | (Not Collected) |
| | | BG-03 | (Not Collected) |
| | | BG-04 | Dewatered Solids from VCM-E WWT System |
| | | BG-05 | Rainwater/Padwater from VCM-A |
| | | BG-06 | Sulfide Treatment Sludge |
| Vulcan Chemicals; Geismar, LA | 6/5/97 | VG-01 | Steam Stripper Bottoms/Effluent |
| | | VG-02 | (Not Collected) |
| | | VG-03 | Steam Stripper Bottoms/Effluent |

⁴Blanks and MS/MSD samples are not included in this list. Please refer to the QAPP and site-specific analytical data reports contained in the docket for this rulemaking for discussions of these samples and associated results.

⁵Samples collected from this facility were treated as familiarization samples for dioxin/furan analyses, however, the dioxin/furan analytical results for these samples ultimately were used with the remainder of the record samples.

| Site Name | Sample Date | Sample Number | Sample Name |
|--|-------------|---------------|--|
| | | VG-04 | (Not Collected) |
| | | VG-05 | WWT Headworks - Air Stripper Feed |
| | | VG-06 | WWT System Feed to Neutralization (After Air Stripper) |
| DuPont Dow Elastomers; LaPlace, LA | 7/10/97 | DD-01 | (Not Collected) |
| | | DD-02 | (Not Collected) |
| | | DD-03 | DCB Isomerization Scrubber Water |
| | | DD-04 | WW for HCL Recovery |
| | | DD-05 | CD Brine from Steam Stripping |
| Occidental Chemical Company; Convent, LA | 7/11/97 | OC-01 | EDC Wastewater Stripper Bottoms |
| | | OC-02 | Wastewater Treatment Sludge |
| PPG; Lake Charles, LA | 7/14/97 | PL-01 | OHC Stripper Bottoms |
| | | PL-02 | Perc/Tri Stripper Bottoms |
| | | PL-03 | WTU Stripper Bottoms |
| | | PL-04 | Metal Hydroxide Sludge |
| Shell Chemical; Norco, LA | 7/15/97 | SN-01 | HCL Scrubber Water |
| | | SN-02 | Caustic Scrubber Water |
| | | SN-03 | Equalization Effluent (Tank 202) - Plant WW |
| | | SN-04 | Wastewater Prior to Aeration (Tank 251) - Combined Plant and Refinery WW |
| | | SN-05 | Wastewater Treatment Sludge |
| Dow Chemical; Freeport, TX | 7/17-18/97 | DF-01 | WW from EDC OHC, Unit V |
| | | DF-02 | Biological WWT Sludge |
| | | DF-03 | WW from EDC OHC, Unit I |
| | | DF-04 | WW from Trichloroethylene Plant |
| | | DF-05 | WW Headworks to Biological Treatment, Specialty |
| | | DF-06 | WW Headworks to Biological Treatment, Chlorohydrin |
| | | DF-07 | CEP WW from VDCM Production |
| | | DF-08 | CMP WW from Quench/Stripping |
| | | DF-09 | CMP WW from Cooling/ Drying/ Neutralization |
| Geon; Laporte, TX | 7/21/97 | GL-01 | WWT Sludge |
| | | GL-02 | WW from EDC/VCM, After Stripping |

3. MANUFACTURING AND WASTEWATER TREATMENT PROCESS DESCRIPTIONS

Section 4 presents the Agency's evaluation on whether wastewaters and wastewater treatment sludges from chlorinated aliphatics manufacturing processes should be listed as hazardous wastes. This section presents the manufacturing processes that generate at least one wastewater and on wastewater treatment systems that generate wastewater treatment sludges. Process descriptions are presented and points of waste generation are identified for the manufacturing and waste management operations evaluated in the Chlorinated Aliphatics industry study. Section 3.1 describes the manufacturing processes and points of waste generation, and Section 3.2 describes the waste treatment processes generating wastes of concern.

3.1 Chlorinated Aliphatics Manufacturing Processes

The chlorinated aliphatics manufacturing processes have been organized in to the following waste groups based on the proposed listings:

- Ethylene dichloride/Vinyl Chloride Monomer
Wastewater treatment sludge
- Vinyl Chloride Monomer from Acetylene
Wastewater
Wastewater treatment sludge
- Methyl chloride
Wastewater treatment sludge
- Allyl chloride
Wastewater treatment sludge
- Other (remaining processes)
Wastewaters
 - Chlorinated methanes
 - Chloroprene and [REDACTED]
 - Methyl chloroform
 - Vinylidene chloride monomer
 - Trichloroethylene
 - Hexachlorocyclopentadiene
 - Methallyl chloride
 - Perchloroethylene/Trichloroethylene/Carbon tetrachloride

These groups are based the proposed hazardous waste definitions for K173, K174, and K175. K173 wastes are wastewaters from generated from the production EDC and VCM, except

wastewaters generated from the production of VCM from acetylene; K174 wastes are wastewater treatment sludges generated from the production of EDC and VCM; and K175 are wastewater treatment sludges generated from the production of VCM using mercuric chloride catalyst in an acetylene-based process. Each of these processes generated at least one wastewater. Additional chlorinated aliphatic manufacturing processes were identified, however these processes did not generate any process wastewaters.

3.1.1 Ethylene Dichloride (EDC or 1,2-dichloroethane) and Vinyl Chloride Monomer (VCM or chloroethene)

Ethylene dichloride and vinyl chloride monomer manufacture are the most common processes in the chlorinated aliphatics industry. In most cases, EDC is manufactured for captive use in the production of vinyl chloride monomer. However, at some facilities, EDC is manufactured as a product for sale or use as an intermediate for other products that include tetrachloroethylene, 1,1,2-trichloroethane, and trichloroethylene.

Following the manufacture of VCM, many facilities consume VCM on-site as an intermediate in the manufacture of polyvinyl chloride (PVC). This polymerization reaction is not within the scope of this listing determination, and was not investigated in the course of this industry study. Other uses for VCM include the production of 1,1,1-trichloroethane (methyl chloroform) which is addressed in Section 3.1.7 of this document.

From the industry study, there are 17 EDC and/or VCM manufacturing processes at 15 facilities (12 processes manufacture EDC and VCM, while the remaining five only manufacture EDC). EDC/VCM manufacture accounts for the vast majority of the chlorinated aliphatics industry market share (>85% based on reported 1996 production). A summary of the facilities manufacturing EDC and/or VCM is provided in Table 3-1. Since completion of the industry study, PHH Monomers in Lake Charles, LA, began producing EDC and VCM in late 1996. Because this facility came online after completion of the industry study, only limited plant-specific information on production is included in this background document.

Table 3-1. EDC/VCM Manufacturers

| Facility Name | Production Process(es) |
|--|--|
| Borden Chem and Plastic; Geismar, LA | EDC/VCM balanced process |
| Condea Vista Company; Westlake, LA (formerly Vista Chemical) | EDC/VCM balanced process |
| Dow Chemical; Freeport, TX | EDC/VCM balanced process EDC only (direct chlorination) |
| Dow Chemical; Plaquemine, LA | EDC/VCM balanced process |
| Formosa Plastics Corp; Baton Rouge, LA | EDC/VCM balanced process |
| Formosa Plastics Corp; Point Comfort, TX | EDC/VCM balanced process |
| The Geon Company; LaPorte, TX | EDC/VCM balanced process |
| Georgia Gulf Corporation; Plaquemine, LA | EDC/VCM balanced process |
| Oxy Chemical Corp.; Deer Park, TX | EDC/VCM balanced process |
| Occidental Chemical Corp; Convent, LA | EDC only (direct chlorination) |
| Oxymar; Gregory, TX | EDC/VCM balanced process |
| Occidental Chemical Corp, Gregory, TX | EDC only (direct chlorination) |
| PHH Monomers, Lake Charles, LA* | EDC/VCM |
| PPG Industries, Inc.; Lake Charles, LA | EDC/VCM balanced process EDC only (direct chlorination) |
| Vulcan Materials Company; Geismar, LA | EDC only [REDACTED] |
| Westlake Monomers Corp.; Calvert City, KY | EDC/VCM balanced process |

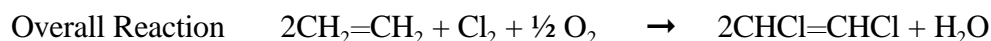
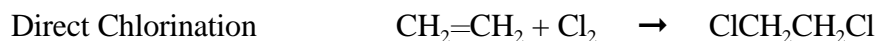
* Joint venture between PPG and Condea Vista that began operation in fourth quarter 1996.

3.1.1.1 Process Descriptions

EDC and VCM are commonly manufactured in the chlorinated aliphatic industry by the “balanced process.” The balanced process consists of three primary reaction steps:

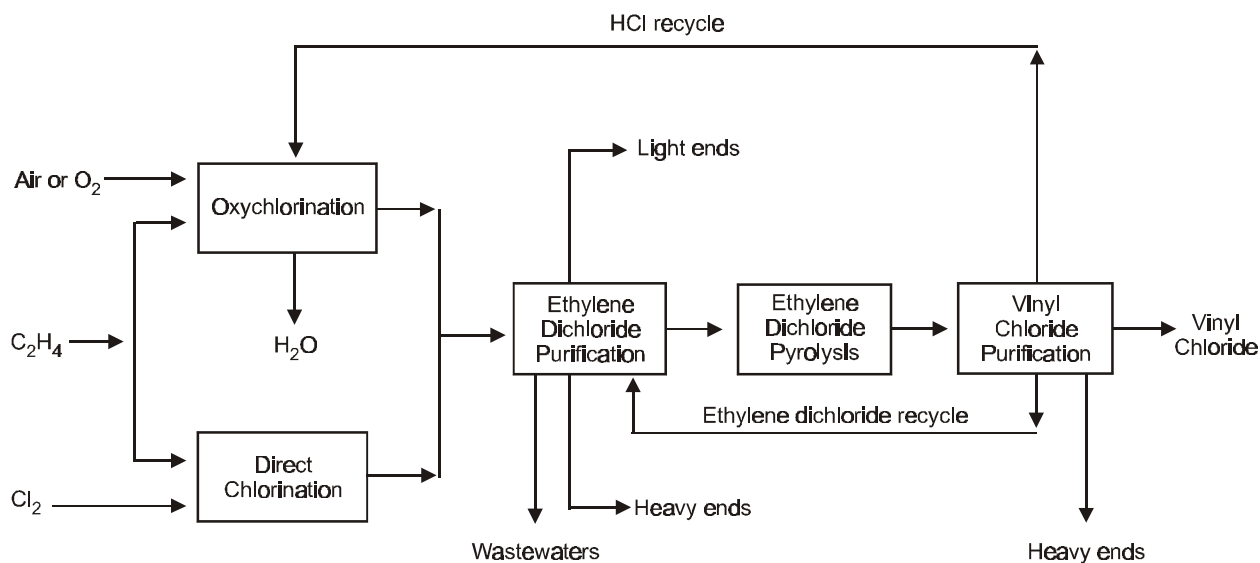
- 1) direct chlorination of ethylene to produce EDC
- 2) thermal cracking or pyrolysis of EDC to produce VCM and hydrogen chloride (HCl)
- 3) oxychlorination of ethylene and HCl from thermal cracking to produce additional EDC

The component reactions and overall reaction are as follows:



Overall, the EDC production between direct chlorination and oxychlorination is evenly split, and this process results in no net production or consumption of HCl; hence the “balanced process.” All the HCl produced in the EDC pyrolysis step is used as the feed for oxychlorination. Figure 3-1 presents a generic process flow diagram for the EDC/VCM balanced process.

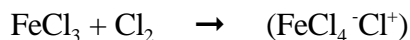
Figure 3-1. Generic EDC/VCM Balanced Process

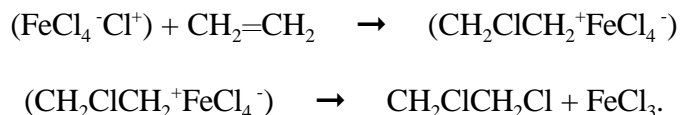


Prior to thermal cracking, the crude EDC undergoes purification. Typically EDC is manufactured as an intermediate in the subsequent manufacture of VCM. However, in some cases EDC is manufactured on-site and sent off-site as product or used as an intermediate for other organic chemicals. In most cases, direct chlorination of EDC is used unless there is a convenient source of HCl available. In addition, there is one facility in the United States which manufactures VCM via hydrochlorination of acetylene (this manufacturing process is discussed separately in Section 3.1.2.)

Addition (Direct) Chlorination to Produce Ethylene Dichloride:

Addition (or direct) chlorination, also referred to as catalytic chlorination, is typically carried out in the vapor or liquid phase and uses an accelerator such as ferric chloride, aluminum chloride, antimony pentachloride, or cupric chloride catalyst. The reaction is also influenced by light, the walls of the reactor vessel, and inhibitors such as oxygen. The typical commercial reaction involves the chlorination of ethylene at 40-50°C with ferric chloride in a liquid phase reactor. The following equations illustrate the reactions.

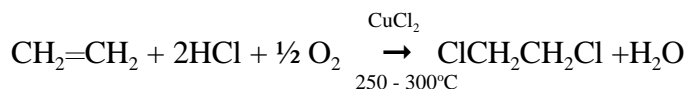




Crude EDC product then exits the reactor and travels as an overhead gas to a condenser system that separates the EDC from noncondensable light ends. After condensation, crude EDC product is combined with crude EDC from the oxychlorination section (described in the next section) and forwarded to EDC purification.

Oxychlorination to Produce Ethylene Dichloride

In the presence of oxygen or air and a cupric chloride catalyst, ethylene and hydrogen chloride react to produce EDC and water. In the balanced process, the source of HCl is typically generated from the pyrolysis of EDC to VCM. However, in some of the EDC-only manufacturing processes, HCl may be supplied from other sources. This reaction can take place in a fluidized or fixed bed reactor and produces ethylene dichloride and water in the following reaction.



The product gas stream is sent to a condenser to separate unreacted ethylene from EDC. The unreacted ethylene is recycled back to the reactor as raw material, and EDC proceeds to a phase separator, where crude EDC is separated from process wastewater and washed with caustic to neutralize any residual HCl or chlorine. Crude EDC is then dried to eliminate any water and forwarded with the crude EDC from the addition chlorination process to purification, before thermal dehydrochlorination (thermal cracking) to VCM.

Ethylene Dichloride Purification:

Prior to thermal cracking into VCM, crude EDC enters a sequence of distillation columns to remove light and heavy impurities. The first sequence removes condensable and noncondensable light impurities. By-product, condensable light impurities are removed as tops and sent to an on-site industrial furnace while non-condensable light impurities are discharged as vent (or inerts that must be purged from the process) and sent to a gas incinerator. The bottoms stream is forwarded to a second distillation sequence to remove heavy impurities. Noncondensable impurities are again removed from the top and discharged to a gas incinerator. High-purity EDC is also removed from the top and advanced to the EDC cracking furnaces while bottoms are refinement. From the Dopp kettle, by-product heavies are sent to the on-site industrial furnace, and bottoms are discharged for off-site waste management.

Thermal dehydrochlorination of Ethylene Dichloride to Produce Vinyl Chloride Monomer:

Thermal dehydrochlorination of EDC, also known as thermal cracking, produces VCM and co-product hydrogen chloride.



This reaction routinely takes place in a cracking furnace operating at temperatures ranging from 425-550°C to convert approximately half the purified EDC into VCM and HCl. The product stream is sent to a quenching tower and proceeds to an absorber to remove the HCl by-product. HCl is directed back to the oxychlorination process and used to produce crude EDC. By-product VCM proceeds, along with unreacted EDC, to a VCM stripper and product still for separation. Unreacted EDC is added to crude EDC from oxychlorination and recycled to the cracking furnace. VCM is neutralized with caustic and sent to product storage.

3.1.1.2 Waste Generation and Management

This section focuses on the wastes of concern: wastewaters and wastewater treatment sludges. The wastewater streams are produced during the EDC/VCM manufacturing process from the distillation and purification steps, scrubbers used during start-up/shut-down, crude product washings, phase separation, rainwater, and equipment washdowns. Wastewater treatment sludges are generated from the treatment these wastewaters.

Wastewaters

Two types of wastewater streams are commonly generated from the manufacture of crude EDC. The most common process wastewater consists of water generated as a by-product from the oxychlorination reaction that is separated from the organic EDC phase; this aqueous phase also includes other process wastewaters from caustic washing of wet crude EDC and removal of water from wet EDC. The second type of wastewater generated from various ancillary process activities including: scrubber waters generated during start-up/shut-down operations, drainage wastewaters generated from equipment washdown, and rainwater in the process areas. These wastewaters are typically generated intermittently, and are commonly commingled with the other process wastewaters prior to management.

All EDC/VCM wastewaters are treated in RCRA-exempt tank-based systems or are directly piped to adjacent privately-owned treatment works (PrOTWs). The majority of the on-site treatment systems employ biological wastewater treatment. However, some facilities utilize steam stripping and or carbon treatment only. It should be noted that there are several small volume, periodically generated wastewaters which were reported to be either incinerated or landfilled. These wastewaters are typically generated during reactor clean-outs. A small number

of wastewaters were reported to be re-used on-site. At some facilities, acidic wastewaters generated from HCl removal or recovery from the vent gases are used for pH control in the wastewater treatment system, or in other areas of the plant. Section 3.2 provides additional details on wastewater treatment systems in use in the chlorinated aliphatics industry.

Wastewater Treatment Sludges

Wastewater treatment sludges are generated from the treatment EDC/VCM wastewaters. Sludges are generally dewatered using either plate-and-frame filter presses or belt filter presses and dewatered sludge is temporarily stored in roll-off containers prior to on-site or off-site transportation and management. The two most common management methods employed for EDC/VCM sludges are on- or off-site incineration or landfilling. In all cases, incinerators are permitted for management of hazardous wastes, while both Subtitle D and Subtitle C landfills are employed. In addition, one facility (Georgia Gulf; Plaquemine, LA) utilizes an on-site land treatment unit.

Other Wastes (not within scope of this listing determination)

Other wastes generated by EDC/VCM manufacture include distillation bottoms, spent catalysts, cleanout wastes, and other residuals. In general, at least one of the following listed waste codes may apply to these residuals:

- F024 process wastes (distillation residues, heavy ends, tars, cleanout) from production of chlorinated aliphatics
- F025 condensed light ends, spent filter/filter aids, and spent desiccants from production of chlorinated aliphatics
- K020 VCM still bottoms
- D043 wastes exhibits toxicity characteristic for vinyl chloride

3.1.2 Vinyl Chloride Monomer Using Acetylene as a Raw Material (VCM-A)

Historically, vinyl chloride monomer was first produced commercially in the 1930s from the reaction of HCl with acetylene. In the 1950s, ethylene became a more plentiful and cheaper feedstock, and commercial processes were developed to produce vinyl chloride from ethylene and chlorine. Today, production of vinyl chloride monomer based on acetylene is less common than the aforementioned EDC/VCM balanced process using ethylene as feedstock. The Agency's industry study identified only one chlorinated aliphatics facility (Borden Chemicals and Plastics; Geismar, LA) using the acetylene-based process. This process represents approximately 1.25% of the total chlorinated aliphatics industry market share in the U.S., and produces only a small fraction of total vinyl chloride monomer in comparison to the balanced process. It should be noted

that this facility has recently expanded its VCM production capacity using this process. (See Section 2.1.2 -- Recent Developments.)

3.1.2.1 Process Description

This process uses acetylene and anhydrous hydrogen chloride as raw materials in a hydrochlorination reaction to produce vinyl chloride monomer. The basic process chemistry is shown below.



In the Borden process, acetylene from the on-site acetylene plant is first purified to remove water. Following drying, the acetylene is mixed with anhydrous hydrogen chloride (HCl) and flows through tubular reactors containing mercuric chloride catalyst. The acetylene and HCl react to form VCM. There are a series of reactors at the facility consisting of primary, secondary and vent reactors. The product gas stream from the primary reactors is condensed and sent to a liquid-vapor phase separator. The vapor from the phase separator is mixed with anhydrous HCl and unreacted acetylene from downstream purification and fed to the secondary reactors. Reaction products from the secondary reactors is condensed and phase separated. The vapor phase is sent to the vent reactor. The vent reactor's effluent is condensed and phase separated. The liquid phase from each of the phase separators, consisting primarily of VCM, is forwarded to purification.

The first column in the distillation train is the crude column. In this distillation step, the overheads consist of unreacted HCl and acetylene and are recycled back to the secondary reactors. The bottoms from the crude column then are sent to a series of two more distillation columns to purify VCM product. These units generate product VCM, crude VCM that is sent to the head of the purification train, and a still bottoms that is sent to a thermal system that recovers the chlorine value as hydrogen chloric acid.

3.1.2.2 Waste Generation and Management

Wastewaters

There are no wastewaters generated directly from the manufacturing process. The reported wastewaters are rainwater and other water (from washing and cleaning) collected from the process area. Due to the presence of mercuric chloride catalyst from catalyst change-outs on the process pad, the padwater (containing mercury) is treated in a sodium sulfide treatment system (described in Section 3.2.2.1) prior to being discharged under an NPDES permit, and is not combined with any other process wastewaters in the plant.

Wastewater Treatment Sludges

Mercury sulfide wastewater treatment sludge is generated from the treatment of the process area padwater. This sludge is dewatered prior to temporary storage on-site in a container. This sludge is managed in an off-site landfill as a nonhazardous waste.

Others (not within the scope of this listing determination)

Additional heavy ends from the VCM purification are incinerated off site as K020 hazardous waste. The stripped chlorinated organic intermediate materials are forwarded to the thermal units for chlorine recovery has HCl. The mercuric chloride catalyst is replaced as the reaction process becomes less effective. The spent catalyst has historically been returned to the manufacturer to utilize and remaining mercury value. Since May, 1994, Borden has actively pursued an alternative mercury recovery process in the United States.

3.1.3 Methyl Chloride

Manufacture of methyl chloride (chloromethane) is the second most common process in the chlorinated aliphatics industry. Three facilities manufacture methyl chloride as an intermediate which is consumed captively in the production of silicones. The remaining facilities manufacture methyl chloride as the first step in an integrated chlorinated methanes process. Because the proposed listing addresses methyl chloride only, this section will focus on those facilities and processes that manufacture methyl chloride only. The manufacture of higher chlorinated methanes are discussed in more detail in Section 3.1.5.1.

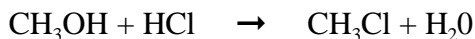
Methyl chloride manufacture accounts for a small percentage of the chlorinated aliphatics industry market share (<3% based on reported 1996 production). A summary of the methyl chloride manufacturing facilities is provided in Table 3-2 on the following page.

Table 3-2. Methyl Chloride Manufacturers

| Facility Name | Production Processes |
|---|----------------------|
| Dow Corning Corporation; Carrollton, KY | Methyl Chloride only |
| Dow Corning Corporation; Midland, MI | Methyl Chloride only |
| GE Electric Corporation; Waterford, NY | Methyl Chloride only |

3.1.3.1 Process Description

Methyl chloride is commercially manufactured by the hydrochlorination of methanol and hydrogen chloride. The chemical reaction is shown below.



The hydrochlorination reaction of methanol and HCl takes place in a liquid phase reaction. The reactor effluent is distilled to remove residual HCl and water as aqueous waste hydrochloric acid. In some cases, this methanol may be recovered from this stream. The methyl chloride stream from the distillation unit is dried and forwarded to product storage or sent on for further conversion to silicones or chlorinated methanes. (See section 3.1.5.1 for discussion on the manufacture of chlorinated methanes.)

3.1.3.2 Waste Generation and Management

Wastewaters

Three facilities reported generating a total of 371,500 metric tons of wastewaters from the production of methyl chloride in 1996. Because the product is washed and water is generated as a by-product of the reaction, acidic wastewaters are generated during product purification. These wastewaters are sent to onsite wastewater treatment.

Wastewater Treatment Sludges

Two facilities reported generating a wastewater treatment sludge. However, only a small percentage of the total wastewater flow to the treatment system can be attributed to methyl chloride production.

Others (not within the scope of this listing determination)

One facility reported generating a spent sulfuric acid (D001) from product drying which is sent off-site for recovery. The spent sulfuric acid undergoes thermal destruction that destroys any organic contaminants and reduces the sulfuric acid to sulfur dioxide (SO₂); sulfuric acid then is regenerated from the SO₂.

3.1.4 Allyl Chloride

One allyl chloride (3-chloro-1-propene) manufacturing process (Shell Chemical, Norco, LA) in the chlorinated aliphatics industry generates wastes within the scope of this listing determination. A second manufacturing process at Dow Chemical, Freeport, TX does not generate any wastes of concern.

3.1.4.1 Process Description

Propylene is reacted with chlorine in a thermal chlorination reaction in the gas phase. The reactor product gas is fed to an allyl chloride prefractionator, which separates allyl chloride from by-product HCl. The crude allyl chloride from the prefractionator is sent to storage, and the HCl is forwarded to an HCl absorber that generates 37% HCl byproduct. The HCl absorber overhead

is sent to a caustic scrubber. In addition, storage vents from storage of the HCl by-product are scrubbed with water.

Following crude allyl chloride storage, the allyl chloride enters a three-stage distillation train. The first column removes light ends, the second column removes heavy ends, and the third column purifies a portion of the allyl chloride to a sales grade. The allyl chloride from the second column, which is not purified to sales grade, is fed to a low residence time chlorohydrinator to produce epichlorohydrin. There is a wastewater that is generated from washing the overhead gas from the second column to knock out any residual allyl chloride. This wash water, containing allyl chloride, also is fed to the chlorohydrinator.

3.1.4.2 Waste Generation and Management

Wastewaters

Two wastewater streams are generated from the manufacture of allyl chloride: caustic scrubber bottoms and HCl scrubber bottoms. These streams are treated in an onsite biological wastewater treatment system with other process wastewaters.

Wastewater Treatment Sludges

This facility reported generating a wastewater treatment sludge. However, only a small fraction (2%) of the total wastewater flow can be attributed to allyl chloride production. Furthermore, this wastewater treatment system accepts process wastewater from the adjacent petroleum refining facility.

Others (not within scope of this listing determination)

The following streams are also generated by this process.

- activated alumina from propylene dryer
- molecular sieve from propylene
- regeneration gases from propylene driers
- coke from allyl chloride reactor
- isopropyl alcohol from clean-out of prefractionator
- coke from crude allyl chloride storage (F024)
- light ends (F025) from allyl chloride purification
- heavy ends (F024) from allyl chloride purification

The activated alumina and spent molecular sieve are managed in an off-site nonhazardous landfill. The regeneration gases are vented to flares. The coke generated from the reactor and allyl chloride storage are incinerated off-site as hazardous and the heavy and light ends are incinerated on-site as hazardous. The isopropyl alcohol stream is managed in the on-site biological wastewater treatment system.

3.1.5 Other Chlorinated Aliphatic Manufacturing Processes

This section describes those chlorinated aliphatics manufacturing processes that generate process wastewaters. However, these facilities commingle chlorinated aliphatic wastewaters with other process wastewaters. In many cases, these wastewater streams are commingled with EDC/VCM wastewaters and would be captured by the proposed listings. Furthermore, in some cases, the contribution to the total wastewater flow is insignificant and the impact and risks associated with these streams cannot be determined with any certainty.

3.1.5.1 Chlorinated Methanes

Chlorinated methanes include methyl chloride (chloromethane, CH_3Cl), methylene chloride (dichloromethane, CH_2Cl_2), chloroform (trichloromethane, CHCl_3), and carbon tetrachloride (tetrachloromethane, CCl_4). Facilities producing only chloromethane are discussed in the Section 3.1.3, while facilities producing product carbon tetrachloride via other processes are discussed in more detail in Section 3.1.5.8. Currently, four facilities produce chlorinated methanes commercially in the U.S. In general, these facilities use the same processes with minor variations at each facility.

Table 3-3. Chlorinated Methanes Manufacturers

| Facility Name | Production Processes |
|---------------------------------------|--|
| Dow Chemical Company; Freeport, TX | Methyl Chloride and other Chlorinated Methanes |
| Dow Chemical Company; Plaquemine, LA | Methyl Chloride and other Chlorinated Methanes |
| Vulcan Chemicals Company; Geismar, LA | Methyl Chloride and other Chlorinated Methanes |
| Vulcan Materials Company; Wichita, KS | Methyl Chloride and other Chlorinated Methanes |

Commercial facilities typically use two reaction steps to produce chlorinated methanes. The first step is methyl chloride (CH_3Cl) via hydrochlorination of methanol and hydrogen chloride and is described in Section 3.1.3. In the second step, methylene chloride (CH_2Cl_2) and chloroform (CHCl_3) co-products are produced along with crude carbon tetrachloride (CCl_4) by-product via thermal chlorination of methyl chloride. The crude reaction products are cooled in a quench system, separated in a condensation unit and finally distilled to yield the two individual pure products. Gaseous hydrogen chloride produced during chlorination is recycled to the hydrochlorinator from the previous step. Several other processes may be used to produce chlorinated methanes, however, none of these processes are performed on a large scale. Figure 3-2 on the following page provides a typical flow diagram for chlorinated methanes production.

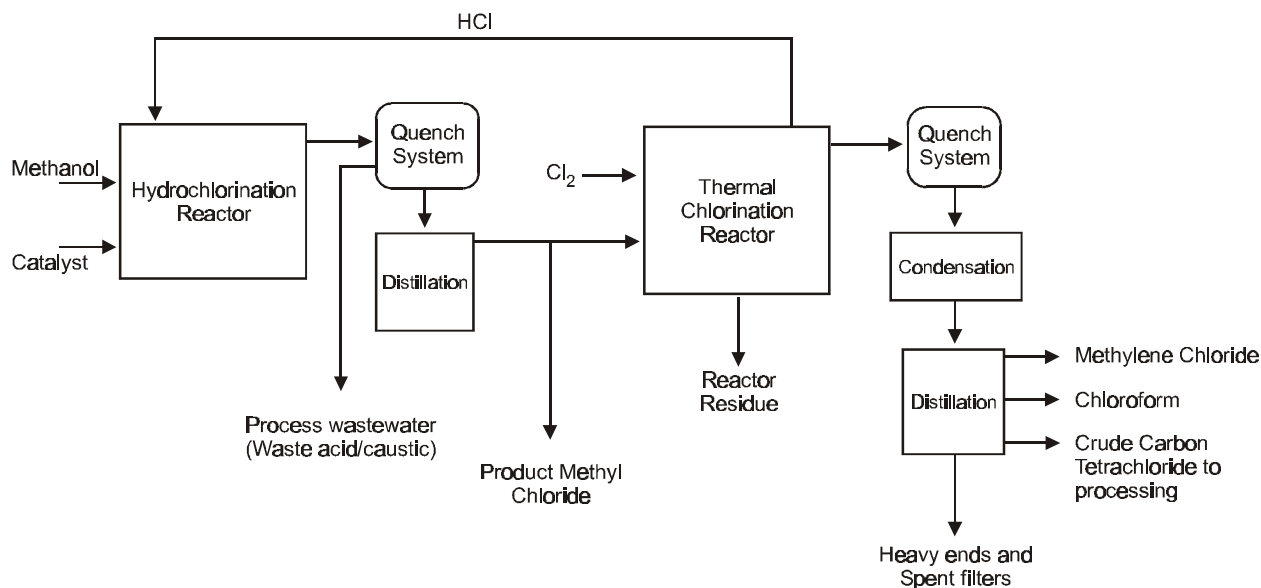


Figure 3-2. Chlorinated Methanes Process Flow Diagram

Chlorinated methanes plants reported generating a total of [REDACTED] MT of wastewaters in 1996. These wastewaters are typically generated from the methanol hydrochlorination step where methyl chloride is dried and purified. By-product water from the reaction and subsequent methyl chloride wash steps generate the bulk of the wastewater. Wastewater treatment sludges were reported to be generated by these facilities, however chlorinated methanes wastewaters make up a very small portion of the total wastewater flow. Furthermore, these streams are commingled with EDC wastewaters, and any wastewater sludge generated would be captured under the proposed listing.

3.1.5.2 Chloroprene and [REDACTED]

[REDACTED]

In the first process, butadiene, chlorine, and caustic are reacted to form a mixture of 1,4-dichloro-2-butene (1,4-DCB) and 3,4-dichloro-1-butene (3,4-DCB). The crude DCB mixture is sent through a series of vacuum distillation units to remove unwanted organics and to separate and purify the DCB components. 1,4-DCB is sent to an isomerization reactor to convert it to 3,4-DCB. Purified 3,4-DCB is combined with caustic, catalyst, and inhibitors in a series of reactors to dehydrochlorinate the 3,4-DCB to crude chloroprene. The crude chloroprene is steam stripped to remove brine that is formed as part of the reaction, and the purified product is sent to the second process to produce neoprene. This process generates the following wastewaters:

- scrubber wastewaters from DCB production
- brine wastewater from chloroprene stripping unit
- HCl recovery scrubber

The DCB scrubber wastewaters are combined with incinerator scrubber waters and sent to a clarifier to remove organics. The aqueous phase is neutralized with HCl or NaOH and sent to underground injection wells as hazardous waste. The organic phase is incinerated onsite as a hazardous waste. The chloroprene brine is typically sent to a separate clarifier that periodically generates an organic layer which is sent to the onsite incinerator as hazardous waste. Normally, the aqueous phase is neutralized with NaOH or HCl, filtered, and disposed in nonhazardous injection wells. However, it is often combined with the hazardous streams prior to neutralization to help meet specific gravity requirements of the hazardous waste underground injection well. Wastewater from the HCl scrubber is reused onsite for its acid value.

[REDACTED]

[REDACTED]

All the wastewaters are sent to the onsite wastewater treatment system where the streams are neutralized with lime and discharged to a POTW for biological treatment. Wastewater treatment sludges generated from the clarifier are dewatered and managed as hazardous wastes in an onsite incinerator. These facilities generate at total of [REDACTED] metric tons of wastewater from the production of chlorobutadiene and chloroprene.

3.1.5.3 Methyl Chloroform (1,1,1-Trichloroethane)

Methyl chloroform, or 1,1,1-trichloroethane, is commonly produced from (1) thermal or photochemical chlorination of 1,1-dichloroethane, (2) hydrochlorination of 1,1,2-trichloroethane produced from 1,1-dichloroethylene, and (3) direct chlorination of ethane. Two facilities manufacture methyl chloroform in the U.S.. Both facilities use the hydrochlorination of VCM to intermediate 1,1-dichloroethane; 1,1-dichloroethane is then reacted with chlorine to form methyl

chloroform. However, one facility integrates an EDC/VCM balanced process to manufacture VCM as a feedstock for methyl chloroform production.

Ethylidene, or 1,1-dichloroethane, is produced commercially from the hydrochlorination reaction using hydrogen chloride and vinyl chloride. The reactor is followed by a distillation sequence to remove heavy impurities and unreacted feedstocks from crude 1,1-dichloroethane. The unreacted feedstocks are recycled back to the reactor, the impurities are disposed as hazardous wastes, while intermediate 1,1-dichloroethane sent to the chlorination reactors.

1,1-dichloroethane is thermally or photochemically chlorinated to produce methyl chloroform and HCl. Typical by-products from thermal chlorination include HCl, vinyl chloride, vinylidene chloride, tetrachloroethanes, and pentachloroethane. The photochlorination process generates by-products 1,1,2-trichloroethane, tetrachloroethanes, and pentachloroethanes. The reactor effluent from either process is then forwarded to a distillation sequence to separate by-products and impurities from the methyl chloroform product.

By-product HCl is removed by stripping and may be recycled to the 1,1-dichloroethane process for hydrochlorination or other parts of the plant, while other organics and heavy impurities are separated out in the second sequence. By-product 1,1,2-trichloroethane may be sold as final product by some facilities is separated in a final sequence from the 1,1,1-trichloroethane. Along with remaining heavy impurities, it is combined in a distillation sequence with crude product from the 1,1,2-trichloroethane manufacturing process. Refer to section 3.1.13 for further discussion of typical commercial production using by-product 1,1,2-trichloroethane. The methyl chloroform is often blended with inhibitors to make a final product.

Wastewaters are generated primarily from neutralizing and drying steps during methyl chloroform purification. Both facilities reported generated a wastewater treatment sludge, however only a small percentage of the total wastewater flow to the treatment system can be attributed to methyl chloroform production. Furthermore, these wastewaters are commingled with EDC/VCM wastewaters and any wastewater treatment sludges will be captured under the proposed listing.

3.1.5.4 Vinylidene Chloride Monomer (VDCM) or 1,1-Dichloroethylene

Vinylidene chloride monomer is commercially manufactured by the dehydrochlorination of 1,1,2-trichloroethane. Copolymerization with vinyl chloride, acrylonitrile, and various alkylacrylates is one of its most important uses. Two facilities reported manufacturing vinylidene chloride.

1,1,2-Trichloroethane is produced from the direct chlorination of 1,2-dichloroethane (EDC) with chlorine. The reaction stream is distilled to separate unreacted EDC, by-product HCl, and 1,1,2-trichloroethane intermediate. No wastewaters are generated during this process.

1,1,2-trichloroethane and an aqueous alkali, such as lime or sodium hydroxide, are dehydrochlorinated to produce VDCM. By-products from this reaction include water and calcium or sodium chloride. The reactor effluent is usually rinsed, dried, and distilled to eliminate water and impurities. The overhead stream from the first distillation sequence consists of crude VDCM product and must be filtered. Bottoms is forwarded to the second distillation sequence where unreacted 1,1,2-trichloroethane is separated and recycled to the reactor while polymer waste is also removed.

Wastewaters are generated from the vinylidene chloride purification step. As noted in the previous section, water is generated as a by-product of the dehydrochlorination reaction. This stream is treated onsite in a non-biological treatment system and discharged under NPDES. Both facilities reported generating a wastewater treatment sludge, however only a small percentage of the total wastewater flow to the treatment system can be attributed to vinylidene chloride production. Furthermore, these wastewaters are commingled with EDC/VCM wastewaters and any wastewater treatment sludges will be captured under the proposed listing.

3.1.5.5 Trichloroethylene

Subsequent to production from acetylene, trichloroethylene is mostly manufactured in the U.S. from ethylene or 1,2-dichloroethane. With the addition of chlorine, ethylene or dichloroethane can be chlorinated to produce trichloroethylene and by-product tetrachloroethylene. In an oxychlorination process, 1,2-dichloroethane also produces trichloroethylene and by-product tetrachloroethylene (or perchloroethylene). Production of tetrachloroethylene (or perchloroethylene) is further discussed in section 3.1.12. One facility (Dow Chemical, Freeport, TX) reported manufacturing trichloroethylene product and perchloroethylene and HCl byproducts.

Trichloroethylene is produced from direct chlorination and thermal cracking. EDC and chlorine are reacted and quenched with recycled crude product. The heavies are removed and the crude products are forwarded to a series of condensers to remove chlorine and HCl. The condensed organics are sent to an initial distillation step to separate trichloroethylene from the rest of the stream. The trichloroethylene is dried and forwarded to storage and sales. The remaining residual organics are sent to a second distillation step where a light and heavy stream are produced. The light stream is sent to a third distillation to separate crude tetrachloroethylene from crude trichloroethylene. The crude tetrachloroethylene is shipped offsite to another Dow facility for finishing and sales, and the crude trichloroethylene is recycled back for purification. The heavy stream from the second distillation is combined with tetrachloroethane to form a feed for the cracking furnace. Product from the cracking furnace is recycled back to the second distillation step.

Wastewaters are generated from the drying and finishing operations, and approximately 8,171 metric tons of wastewater from the generation of trichloroethylene were reported for 1996. This stream is sent to onsite wastewater treatment in tanks and discharged under NPDES. This

facility reported generating a wastewater treatment sludge, however only a small percentage of the total wastewater flow to the treatment system can be attributed to trichloroethylene production.

3.1.5.6 Hexachlorocyclopentadiene

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

3.1.5.7 Methallyl Chloride

[REDACTED]

[REDACTED]

3.1.5.8 Tetrachloroethylene/Trichloroethylene/Carbon Tetrachloride

In addition to the process described in Section 3.1.5.1, trichloroethylene, tetrachloroethylene, and carbon tetrachloride may be manufactured from a mixed organic feedstock. One facility utilizes oxychlorination to produce trichloroethylene and tetrachloroethylene, another uses thermal chlorination to produce tetrachloroethylene and carbon tetrachloride, and the last facility separates tetrachloroethylene and carbon tetrachloride using organic streams from various onsite processes as feedstock.

Wastewaters are generated only from the oxychlorination process. The other processes do not generate wastewaters. Only a small portion of the total wastewater flow to the treatment system is associated with the tetrachloroethylene/trichloroethylene process, and these wastewaters are commingled with EDC/VCM wastewaters. Therefore, any wastewater treatment sludges will be captured under the proposed listing.

3.1.6 *Manufacturing Processes That Do Not Generate Wastewater*

The following manufacturing processes were identified during the industry study, and were determined not to generate process wastewaters.

- 1,1,2-Trichloroethane (Vinyl Trichloride)
- Ethyl Chloride
- trans-1,2-dichloroethene
- 1,1-dichloroethane
- 1,1,2,2-Tetrachloroethane
- Pentachloroethane
- beta-Trichloroethane

3.2 Waste Treatment Processes

This section presents a summary of the wastewater treatment systems that manage wastewaters generated by the chlorinated aliphatics industry. The following sections will focus on those wastewater systems that manage wastewaters and/or generate sludges included in the proposed listing definitions.

3.2.1 *Biological Wastewater Treatment Systems*

In general, most process wastewaters from EDC/VCM manufacturing operations are sent to a biological wastewater treatment system, along with wastewater from other process units. A treatment system typically consists of primary clarification or sedimentation to remove solids, secondary (biological) treatment and clarification for organics destruction, and polishing prior to discharge under NPDES. The sludges from the primary and/or secondary clarifiers are dewatered and disposed. Wastewater treatment sludges generated from the treatment of EDC/VCM wastewaters are included in the proposed listing. Because many facilities commingle process wastewaters from other chlorinated aliphatics processes, the proposed listing effectively captures wastewaters from chlorinated aliphatics manufacturing processes other than EDC/VCM.

3.2.2 *Non-biological Wastewater Treatment Systems Discharging to NPDES Permitted Sites*

In addition to conventional biological treatment, two facilities reported using non-biological wastewater treatment systems. At the first facility, wastewaters generated from the production of VCM from acetylene are sent to a sulfide treatment to remove mercury. The second facility uses a combination of steam stripping, distillation, metals precipitation, and carbon treatment for its wastewaters.

3.2.2.1 *Mercury Sulfide Treatment*

The sulfide treatment system manages wastewater (e.g, rainwater, wash water) that collects on the VCM-A production area. The collected wastewater is fed to a mix tank where sodium sulfide is added to precipitate mercury as mercury sulfide. Diatomaceous earth is added to aid in the subsequent dewatering step. Precipitated solids are and DE are dewatered in a plate and frame press where it is collected for disposal offsite as a nonhazardous waste. The filtered wastewater is recycled through carbon filters until the mercury concentration is less than 5 ppb and is discharged under NPDES. This wastewater treatment process is typically run on a batch basis.

3.2.2.2 Other Nonbiological Treatment

[REDACTED]

[REDACTED]

3.2.3 Non-Biological Pretreatment Processes Prior to POTW/PrOTW Discharge

In addition, a variety of non-biological pretreatment processes (i.e., steam stripping, pH adjustment, primary clarification) were reported for facilities discharging to POTWs/PrOTWs.

3.2.4 Underground Injection

Two facilities reported disposing their wastewaters via underground injection.

4. WASTE GROUPINGS

The EPA-EDF consent decree specifically addresses two waste streams requiring listing determinations: “wastewaters and wastewater treatment sludges from the production of the chlorinated aliphatics specified in the F024 listing.” However, as a result of the industry study and record sampling program, the Agency determined that, in certain cases, it was more appropriate to further sub-divide these two broad waste categories. The Agency is proposing to list as hazardous three of these waste groupings (see below) and to no-list the remaining three. Section III.A.1 of the preamble to this proposed rule discusses the rationales utilized to develop the following six chlorinated aliphatics waste groupings:

- Wastewaters generated from the production of vinyl chloride monomer using mercuric chloride catalyst in an acetylene-based process (VCM-A Wastewaters, proposed as no-list)
- Wastewaters from the production of chlorinated aliphatic hydrocarbons, except for wastewaters generated from the production of vinyl chloride monomer using mercuric chloride catalyst in an acetylene-based process (proposed as K173),
- Wastewater treatment sludges from the production of vinyl chloride monomer using mercuric chloride catalyst in an acetylene-based process (proposed as K175)
- Wastewater treatment sludges from the production of ethylene dichloride or vinyl chloride monomer (proposed as K174)
- Wastewater treatment sludges from the production of methyl chloride (proposed as no-list)
- Wastewater treatment sludges from the production of allyl chloride (proposed as no-list)

The following sections, organized by waste grouping, provide a summary of the waste generation, management, and characterization data collected during the industry study (detailed summaries of all wastewaters and wastewater treatment sludges, regardless of groupings, are presented in Appendix D. In addition, discussions are provided which describe how these data were utilized in the assessment of potential risks from the management of these wastes.

It is important to understand the nature of wastewater treatment systems in the chlorinated aliphatics industry before reviewing the discussions and data tables in the remainder of this section. As noted in Section 2, the manufacture of a chlorinated aliphatic product is commonly only one of several manufacturing operations occurring at a given facility. The other manufacturing operations may involve different chlorinated aliphatic products, or products outside the scope of this listing determination. However, individual wastewaters generated from all of these operations are typically commingled and managed in a common wastewater treatment system. The combined influent to this wastewater treatment system is referred to as the “headworks.” In the case where all of the wastewaters contributing to the headworks are generated from chlorinated aliphatics processes, the headworks is labeled “dedicated.” A non-dedicated headworks would consist of both chlorinated aliphatics wastewaters and other non-chlorinated aliphatics wastewaters. The same terminology applies to sludges generated from the treatment of the headworks waters (i.e., a “dedicated” sludge is one that is generated from the treatment of a dedicated headworks).

1996 data is presented in each of the tables in Sections 4.1 and 4.2.

4.1 Wastewaters

4.1.1 Proposed No-List: Wastewaters Generated from the Production of Vinyl Chloride Monomer Using Mercuric Chloride Catalyst in an Acetylene-Based Process (VCM-A Wastewaters)

This waste grouping defines a single wastewater generated from the VCM-A manufacturing process utilized by Borden Chemicals and Plastics in Geismar, LA (please refer to Section 3.1.2 for additional details on this manufacturing process.) This wastewater is segregated from all other wastewaters generated at the site and treated in a system dedicated to this waste stream. Waste generation and management statistics for this waste grouping are provided in Tables 4-1 and 4-2 below.

| Table 4-1. Waste Generation Statistics for VCM-A Wastewaters | | | | | |
|--|----------------------------|-------------|-------------|-------------------------------|------------------|
| Facility/Location | Headworks Quantity (Mtons) | % Dedicated | Waste Codes | Managed as HAZ? | Final Management |
| Borden Chemicals and Plastics; Geismar, LA | 22,200 | 100% | -- | RCRA-exempt tank-based system | NPDES |
| Total: | 22,200 | | | | |

| Table 4-2. Waste Management Statistics for VCM-A Wastewater | | | |
|---|--------------|--------------------------------------|----------------------|
| Final Management | # of Streams | # of Streams with Unreported Volumes | Total Volume (Mtons) |
| treatment in tanks to NPDES discharge | 1 | 0 | 22,200 |
| Total | 1 | 0 | 22,200 |

Due to the fact that this waste stream is characteristically hazardous for mercury (see Table 2-6) and is currently managed as a hazardous waste (RCRA-exempt wastewater treatment system), the Agency believes that no additional regulatory action is required to address the risks associated with this waste. See the preamble for this proposed rulemaking for additional details on this no-list decision. As a result, no deterministic or probabilistic risk assessment was performed.

This wastewater was sampled during the Agency's sampling program and assigned sample number BG-05 (see Table 2-6). Table 4-3 provides a summary of the Agency's analytical characterization of this sample.

Table 4-3. Waste Characterization Data for VCM-A Wastewaters

4.1.2 Proposed K173: Chlorinated Aliphatics Wastewaters, excluding VCM-A Wastewaters

This waste grouping consists of all wastewaters generated from chlorinated aliphatics manufacturing with the exception of the wastewater defined in Section 4.1.1. This waste grouping consists of 75 wastewaters generated by the 23 facilities identified in the Industry Study and represents the generation of more than 11 million metric tons of wastewater per year. These wastewaters are commonly commingled with other non-chlorinated aliphatics wastewaters at the headworks, prior to treatment.

Table 4-4 illustrates the chlorinated aliphatics headworks quantities utilized in the risk assessment, including the calculated central tendency and high end values used in the risk assessment. This data *does not* encompass all of the wastewater headworks which will be captured by this waste grouping. For the purposes of the risk assessment, non-dedicated headworks containing less than 50% chlorinated aliphatics wastewaters were not included in the analysis. Table 4-5 provides a complete waste management statistic summary for *all* chlorinated aliphatics wastewaters in this waste grouping. However, it is important to note that Table 4-5 represents a summary of all individual wastewater streams and not combined headworks (see Appendix D for a complete summary of all individual wastewater streams and associated headworks).

| Table 4-4. Waste Generation Statistics for Chlorinated Aliphatics Headworks used in the Risk Assessment | | | | | |
|---|----------------------------------|-------------|-------------|--------------------------------|------------------|
| Facility/Location | Headworks Waste Quantity (Mtons) | % Dedicated | Waste Codes | Managed as HAZ? | Final Management |
| The Geon Company; LaPorte, TX | 962,950 | 100% | -- | RCRA-exempt tank-based systems | NPDES |
| Occidental/OxyMar | 417,000 | 100% | -- | | NPDES |
| PPG Industries; Lake Charles, LA | 324,500 | 100% | -- | | NPDES |
| DuPont-Dow Elastomers; LaPlace, LA | 314,770 | 100% | -- | No | UIC |
| PPG Industries; Lake Charles, LA | 173,600 | 100% | -- | RCRA-exempt tank-based systems | NPDES |
| Occidental/OxyMar | 157,500 | 100% | -- | | NPDES |
| PPG Industries; Lake Charles, LA | 127,250 | 100% | -- | | NPDES |
| Westlake Monomers; Calvert City, KY | 98,000 | 100% | -- | -- | PrOTW |
| Total: | 2,575,570 | | | | |
| Central Tendency (average): | 321,946 | | | | |
| High End (maximum): | 962,950 | | | | |

| Table 4-5. Waste Management Statistics for Individual Chlorinated Aliphatics Wastewaters | | | |
|--|--------------|--------------------------------------|----------------------|
| Final Management | # of Streams | # of Streams with Unreported Volumes | Total Volume (Mtons) |
| treatment in tank to NPDES discharge | 45 | 4 | 9,525,343 |
| treatment in tank to POTW discharge | 11 | 0 | 425,173 |
| treatment in tank to PrOTW discharge | 7 | 0 | 1,017,734 |
| discharge to UIC on-site | 8 | 0 | 497,167 |
| drumming and disposal in Subtitle D Landfill | 1 | 0 | 19 |
| Recovery/re-use/reclamation | 3 | 0 | 26,120 |
| Total | 75 | 4 | 11,491,557 |

For the purposes of assessing risk from the management of this waste stream, the Agency evaluated the manner in which it is currently managed. Regardless of their final disposition, chlorinated aliphatics wastewaters are typically stored or treated in tanks. The Agency assessed the risks associated with treatment in open tanks and found these risks sufficient to support a hazardous waste listing determination. No further assessments were performed. Although treatment in surface impoundments was reported for five facilities in 1991, and for two facilities in 1996, the Agency confirmed that no surface impoundments are currently utilized for the management of chlorinated aliphatic wastewaters. Therefore, a treatment in surface impoundment scenario was not included in the risk assessment.

| Table 4-6. Selection of Risk Assessment Modeling Scenarios: Chlorinated Aliphatics Wastewaters | |
|--|---|
| Management | Basis for Consideration in Risk Assessment |
| treatment in tank to NPDES discharge | treatment in an open tank was assessed as it was considered to be a management practice of concern and is currently in use |
| treatment in tank to POTW discharge | treatment in an open tank was assessed as it was considered to be a management practice of concern and is currently in use |
| treatment in tank to PrOTW discharge | treatment in an open tank was assessed as it was considered to be a management practice of concern and is currently in use |
| discharge to UIC on-site | treatment in an open tank was assessed as it was considered to be a management practice of concern and is currently in use |
| drumming and disposal in Subtitle D Landfill | Not included: This management practice was reported for a small volume of wastewater generated during reactor clean-out operations on a periodic basis. |
| Recovery/re-use/reclamation | treatment in an open tank was assessed as it was considered to be a management practice of concern and is currently in use |

As a part of the record sampling program, the Agency collected 40 wastewater samples included in this waste grouping (representing both individual wastewater and headworks samples). However, for the risk assessment, the Agency only used samples OG-01, OG-03, PL-01, PL-02, PL-03, and GL-02. Table 4-7 provides a summary of the analytical characterization of this waste grouping used by the Agency in the risk assessment, including calculated central tendency and high end concentrations.

Table 4-7. Waste Characterization Data for Chlorinated Aliphatics Wastewaters

Table 4-7. Waste Characterization Data for Chlorinated Aliphatics Wastewaters (cont.)

Table 4-7. Waste Characterization Data for Chlorinated Aliphatics Wastewaters (cont.)

4.2 Wastewater Treatment Sludges

4.2.1 *Proposed K174: EDC/VCM Wastewater Treatment Sludges, excluding VCM-A Sludge*

This waste grouping consists of all sludges generated from the treatment of EDC/VCM wastewaters, excluding sludge generated from the treatment of VCM-A wastewater. Please refer to Sections 3.1.1 and 3.2 for additional details on the manufacture of EDC/VCM and wastewater treatment systems utilized to manage these wastewaters. This waste grouping consists of 16 wastewater treatment sludges generated by 12 facilities.

As discussed previously, many wastewater treatment systems handling EDC/VCM wastewaters also handle other chlorinated aliphatic and non-chlorinated aliphatic wastewaters. As a result, this waste grouping captures a large volume of sludge which would not otherwise be captured if these wastewater streams were segregated. The total volume of sludge captured by this waste grouping (based on 1996 data) is 104,561 Mtons. In order to estimate the volume of EDC/VCM sludge attributable to only the EDC/VCM wastewaters, the Agency calculated “apportioned” volumes. An apportioned volume is equal to the total sludge volume multiplied by the percentage of EDC/VCM wastewaters contributing to the total wastewater volume treated⁶. The total 1996 apportioned EDC/VCM volume is 6,574 Mtons.

Table 4-8 illustrates the apportioned EDC/VCM sludge quantities utilized in the risk assessment, including the calculated central tendency and high end values used in the risk assessment. This table includes *all* of the EDC/VCM sludges reported to be generated in 1996. There were two instances where two sludges generated at different facilities were reported to be disposed at the same facility. As a result, these two pairs of quantities were treated as a single commingled waste volume in the risk assessment. Each of these four individual waste volumes are presented in Appendix D. Please note that the italicized quantities (those wastes which are already hazardous) were not utilized in the risk assessment.

Table 4-9 provides a complete waste management statistic summary for *all* EDC/VCM wastewater treatment sludges. Management practices employed for these wastes were limited to landfilling, incineration, and a single occurrence of land treatment.

The Agency conducted both a deterministic and probabilistic risk assessment for this waste grouping for two separate management scenarios: land treatment and landfilling. These two management scenarios represent the only management practices employed for nonhazardous EDC/VCM sludges, and also are the management practices of most concern. The Agency decided to use analytical data associated only with dedicated sludge samples to eliminate the contribution of non-chlorinated aliphatic constituents. As a result, the Agency felt it was necessary to use apportioned sludge volumes in the risk assessment.

⁶In other words, for a facility with a wastewater treatment system generating 100 Mtons of sludge that treats 75% EDC/VCM wastewaters and 25% non-chlorinated aliphatic wastewater, their apportioned EDC/VCM sludge volume would be 75 Mtons.

Table 4-8. Waste Generation Statistics for EDC/VCM Sludge

| Facility/Location | Waste Quantity (Mtons) | Apportioned EDC/VCM Waste Quantity (Mtons) ¹ | Waste Codes | Managed as HAZ? | Final Management |
|---|------------------------|---|----------------|-----------------|----------------------------|
| Dow Chemical; Freeport, TX | 72,223 | 115.5 | -- | No | Subtitle D Landfill |
| Dow Chemical; Midland, MI | 11,100 | 95.5 | -- | No | Subtitle D Landfill |
| Dow Chemical; Freeport, TX | 5,627 | 101 | -- | Yes | Subtitle C Landfill |
| Formosa; Point Comfort, TX | 4,508 ² | 1,104.4 ² | -- | No | Subtitle D Landfill |
| OxyMar; Gregory, TX | | | -- | No | Subtitle D Landfill |
| Borden; Geismar, LA | 5,104 ² | 892.3 ² | -- | No | Subtitle D Landfill |
| PPG Industries, Lake Charles, LA | | | -- | No | Subtitle D Landfill |
| The Geon Company; LaPorte, TX | 1,804 | 1,804 | -- | No | Subtitle D Landfill |
| Georgia Gulf, Plaquemine, LA | 1,750 | 624.2 | -- | No | Land Treatment |
| Formosa; Baton Rouge, LA | 700 | 107.3 | -- | No | Subtitle D Landfill |
| <i>Occidental/OxyMar; Gregory, TX³</i> | 625 | 625 | <i>F and K</i> | <i>Yes</i> | <i>Subtitle C Landfill</i> |
| Occidental; Convent, LA | 500 | 500 | -- | No | Subtitle D Landfill |
| <i>Occidental; Deer Park, TX³</i> | 442 | 442 | <i>K</i> | <i>Yes</i> | <i>Subtitle C Landfill</i> |
| Occidental; Gregory, TX | 160 | 160 | -- | No | Subtitle D Landfill |
| <i>Condea Vista; Westlake, LA³</i> | 11 | 1.6 | <i>D</i> | <i>Yes</i> | <i>Incinerate as HAZ</i> |
| | 7 | 1.1 | <i>D</i> | <i>Yes</i> | <i>Incinerate as HAZ</i> |
| <i>Dow Chemical; Freeport, TX³</i> | 0 ⁴ | 0 ⁴ | <i>D</i> | <i>Yes</i> | <i>Subtitle C Landfill</i> |
| Total: | 104,561 | 6,574 | | | |
| Central Tendency (average) ³ | | 542.2 | | | |
| High End (maximum) ³ | | 1804 | | | |
| Totals used in Risk Assessment ³ | 103,476 | 4,880 | | | |

¹ Quantities calculated based on the percentage of EDC/VCM wastewaters contributing to the wastewater treatment system headworks generating the sludge

² Due to evidence of co-management, individual wastes were treated as a single combined waste quantity for the purposes of the risk assessment

³ *Italics denote wastes not incorporated into the EDC/VCM sludge risk assessment (not used in calculation of central tendency or high end)*

⁴ This sludge was not generated in 1996.

| Table 4-9. Waste Management Statistics for EDC/VCM Sludge | | | |
|---|--------------|--------------------------------------|----------------------|
| Final Management | # of Streams | # of Streams with Unreported Volumes | Total Volume (Mtons) |
| Storage in pile on-site, on-site land treatment unit | 1 | 0 | 1,750 |
| Storage in container on-site, Subtitle C incineration (on- or off-site) | 3 | 1 | 18 |
| Storage in container on-site, on-site Subtitle D landfill | 2 | 0 | 83,323 |
| Storage in container on-site, off-site Subtitle D landfill | 8 | 0 | 12,776 |
| Storage in container on-site, on-site Subtitle C landfill | 1 | 0 | 5,627 |
| Storage in container on-site, off-site Subtitle C landfill | 2 | 0 | 1,067 |
| Total | 17 | 1 | 104,561 |

| Table 4-10. Selection of Risk Assessment Modeling Scenarios: EDC/VCM Sludge | |
|---|--|
| Management | Basis for Consideration in Risk Assessment |
| Subtitle D Landfill (on or offsite) | management practice currently being used, considered to be of concern |
| Subtitle C Landfill (on or offsite) | Not evaluated: risks posed by wastewater treatment sludges managed as hazardous wastes are already addressed by Subtitle C waste management controls |
| On-site Land Treatment | management practice currently being used; considered to be of concern |

The Agency collected eight (8) samples of EDC/VCM wastewater treatment sludge. These samples were assigned the following identification numbers: OG-04, OG-05, OG-06, GL-01, PL-04, OC-02, DF-02, and BG-04 (see Table 2-6). Complete analytical data summaries are provided for each of these samples in Appendix B. Of these eight, five samples (OG-04, OG-05, OG-06, GL-01, and OC-02) were of dedicated EDC/VCM wastewater treatment systems, however one of the five (OG-05) is currently a hazardous waste. The remaining four dedicated samples were used in the risk assessment, and are presented in Table 4-11 with calculated central tendency and high end concentrations.

Table 4-11. Waste Characterization Data for EDC/VCM Sludges

Table 4-11. Waste Characterization Data for EDC/VCM Sludges (cont.)

Table 4-11. Waste Characterization Data for EDC/VCM Sludges (cont.)

4.2.2 Proposed K175: VCM-A Wastewater Treatment Sludges

VCM-A wastewater treatment sludge is generated at Borden Chemicals and Plastics in Geismar, LA from the treatment of the VCM-A wastewater discussed in Section 4.1.1. Please refer to Sections 3.1.2 and 3.2 for additional details on the manufacture of VCM-A and the wastewater treatment system utilized to manage these wastewaters. Waste generation and management statistics for this waste stream are provided in Tables 4-12 and 4-13.

| Table 4-12. Waste Generation Statistics for VCM-A Sludge | | | | | |
|--|------------------------|--|-------------|-----------------|---------------------|
| Facility/Location | Waste Quantity (Mtons) | Apportioned VCM-A Waste Quantity (Mtons) | Waste Codes | Managed as HAZ? | Final Management |
| Borden Chemicals and Plastics; Geismar, LA | 120 | 120 | -- | Yes | Subtitle C Landfill |
| Total: | 120 | 120 | | | |

| Table 4-13. Waste Management Statistics for VCM-A Sludge | | | |
|--|--------------|--------------------------------------|----------------------|
| Final Management | # of Streams | # of Streams with Unreported Volumes | Total Volume (Mtons) |
| Storage in container on-site to off-site Subtitle C Landfill | 1 | 0 | 120 |
| Total | 1 | 0 | 120 |

The agency did not perform a deterministic or probabilistic risk assessment for this waste. The results of a groundwater screening analysis in combination with consideration of additional listing criteria served as the basis for this hazardous waste listing. Please refer to the preamble for this proposed rulemaking for more details on this decision.

This sludge was sampled during the Agency's sampling program and assigned sample number BG-06 (see Table 2-6). Table 4-14 provides a summary of the Agency's analytical characterization of this sample.

Table 4-14. Waste Characterization Data for VCM-A Sludge

4.2.3 Proposed No-List: Methyl Chloride Wastewater Treatment Sludges

This waste grouping consists of all sludges generated from the treatment of methyl chloride wastewaters. Please refer to Sections 3.1.3 and 3.2 for additional details on the manufacture of methyl chloride and wastewater treatment systems utilized to manage these wastewaters. There are three methyl chloride sludges generated from two facilities, representing the generation of [REDACTED] metric tons of sludge per year.

Table 4-15 illustrates the methyl chloride sludge quantity utilized in the risk assessment, including the calculated central tendency and high end values used in the risk assessment. This table includes *all* of the methyl chloride sludges reported to be generated in 1996. Please note that the italicized quantities (those wastes which are already hazardous) were not utilized in the risk assessment.

Table 4-16 provides a complete waste management statistic summary for *all* methyl chloride wastewater treatment sludges. Management practices employed for these wastes were limited to landfilling.

| Table 4-15. Waste Generation Statistics for Methyl Chloride Sludge | | | | |
|---|------------------------|-------------|-----------------|----------------------------|
| Facility/Location | Waste Quantity (Mtons) | Waste Codes | Managed as HAZ? | Final Management |
| Dow Corning; Carrollton, KY | 776 | -- | No | Subtitle D Landfill |
| <i>GE Electric; Waterford, NY²</i> | [REDACTED] | <i>F039</i> | <i>Yes</i> | <i>Subtitle C Landfill</i> |
| | [REDACTED] | | | |
| Total: | [REDACTED] | | | |
| Total used in Risk Assessment for both central tendency and high end: | 776 | | | |

¹ Quantities calculated based on the percentage of methyl chloride wastewaters contributing to the wastewater treatment system headworks generating the sludge

² *Italics denote wastes not incorporated into the EDC/VCM sludge risk assessment (not used in calculation of central tendency or high end)*

| Table 4-16. Waste Management Statistics for Methyl Chloride Sludge | | | |
|--|--------------|--------------------------------------|----------------------|
| Final Management | # of Streams | # of Streams with Unreported Volumes | Total Volume (Mtons) |
| Storage in container on-site, on-site Subtitle D landfill | 1 | 0 | 776 |
| Storage in container on-site, on-site Subtitle C landfill | 2 | 0 | |
| Total | 3 | 0 | |

The Agency conducted both a deterministic and probabilistic risk assessment for this waste grouping for a single management scenarios: landfilling. This management scenario represents the only management practice employed for nonhazardous methyl chloride sludges, and also is the management practices of most concern. The Agency used the only analytical data available for this waste grouping: a single non-dedicated sludge sample. As a result, the Agency felt it was necessary to use total (non-apportioned) sludge volume in the risk assessment.

| Table 4-17. Selection of Risk Assessment Modeling Scenarios: Methyl Chloride Sludge | |
|---|--|
| Management | Basis for Consideration in Risk Assessment |
| On-site Subtitle D Landfill | management practice currently being used, considered to be of concern |
| On-site Subtitle C Landfill | Not evaluated: risks posed by wastewater treatment sludges managed as hazardous wastes are already addressed by Subtitle C waste management controls |

One of the three sludges presented in Table 4-15 (generated at Dow Corning) was sampled during the Agency's sampling program and assigned sample number DC-01 (see Table 2-6). Table 4-18 provides a summary of the Agency's analytical characterization of this sample.

Table 4-18. Waste Characterization Data for Methyl Chloride Sludges

4.2.4 Proposed No-List: Allyl Chloride Wastewater Treatment Sludges

This waste grouping consists of all sludges generated from the treatment of allyl chloride wastewaters. Please refer to Sections 3.1.4 and 3.2 for additional details on the manufacture of allyl chloride and wastewater treatment systems utilized to manage these wastewaters. There is a single allyl chloride sludge generated from one facility, representing the generation of 69,000 metric tons of sludge per year.

Table 4-19 illustrates the allyl chloride sludge quantity utilized in the risk assessment, including the calculated central tendency and high end values used in the risk assessment. This table includes *all* of the allyl chloride sludges reported to be generated in 1996. Table 4-20 provides a complete waste management statistic summary for *all* allyl chloride wastewater treatment sludges. Management practices employed for these wastes were limited to incineration.

| Table 4-19. Waste Generation Statistics for Allyl Chloride Sludge | | | | | |
|---|------------------------|---|-------------|-----------------|----------------------|
| Facility/Location | Waste Quantity (Mtons) | Apportioned Allyl Chloride Waste Quantity (Mtons) | Waste Codes | Managed as HAZ? | Final Management |
| Shell Chemical; Norco, LA | 380,000 ⁷ | 1,060 | -- | No | Incineration as NHAZ |
| Total: | 380,000 ⁷ | 1,060 | | | |

| Table 4-20. Waste Management Statistics for Allyl Chloride Sludge | | | |
|---|--------------|--------------------------------------|----------------------|
| Final Management | # of Streams | # of Streams with Unreported Volumes | Total Volume (Mtons) |
| Storage in container on-site, on-site NHAZ incineration | 1 | 0 | 380,000 ⁷ |
| Total | 1 | 0 | 380,000 ⁷ |

The agency did not perform a deterministic or probabilistic risk assessment for this waste. The results of an analysis of waste characterization data and the fact that this sludge is generated from a treatment system which is less than 2% dedicated to chlorinated aliphatic wastewaters, in combination with consideration of additional listing criteria served as the basis for this no-listing. Please refer to the preamble for this proposed rulemaking for more details on this decision.

This sludge was sampled during the Agency's sampling program and assigned sample number SN-05 (see Table 2-6). Table 4-21 provides a summary of the Agency's analytical characterization of this sample.

⁷Quantity reported is prior to dewatering (~97% water content).

Table 4-21. Waste Characterization Data for Allyl Chloride Sludge

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Appendix A. RCRA Section 3007 Questionnaire

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Appendix B. EPA Record Sampling Analytical Data

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Table B-1. Analytical Data Summary, Sample by Sample

Appendix C. Industry Split Sample Comparison with EPA Record Sample Data

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Introduction

The U.S. Environmental Protection Agency's Office of Solid Waste (OSW), as directed by Congress in the Hazardous and Solid Waste Amendments of 1984 (HSWA), is undertaking an investigation of the Chlorinated Aliphatic Industry to make hazardous waste listing determinations on industry-specific waste types. This investigation also is mandated by the consent decree between EPA and the Environmental Defense Fund (EDF). The consent decree specifies that the Agency must make listing determinations on wastewaters and wastewater treatment sludges generated from the production of chlorinated aliphatics that are excluded from the F024 and F025 hazardous waste listings. These determinations must be well documented and substantiated to withstand extensive review within the Agency and by the public.

Upon completion of a familiarization sampling and analysis effort, the Agency initiated record sampling and analysis of the two consent decree wastes on April 22, 1997, and culminated with final record sampling event on July 21, 1997. The Agency sampled wastewaters and wastewater treatment sludges from twelve facilities to obtain 52 samples (41 wastewaters and 11 wastewater treatment sludges). All sampling events were conducted according to guidance provided by the *Quality Assurance Project Plan for Listing/BDAT Determination of Wastes Generated from the Manufacture of Chlorinated Aliphatic Hydrocarbons ($C_1 - C_5$)*. All facilities visited during the record sampling phase were entitled to receive duplicate split samples for the purpose of replicating the Agency's analytical effort. After the sample results were submitted to each facility in the form of an analytical data report (ADR), the EPA requested all facilities to provide, if available, the analytical results of the split-sample analyses. The goal of this effort was to gain a better understanding of wastestream chemical composition along with the ability to determine the comparability of the EPA-generated data with Industry split-sample results.

The purpose of this report is to compare facility split-sample analytical data results to the EPA data obtained from the laboratory analysis of Chlorinated Aliphatics Listing Determination Samples. There were a total of 52 (41 wastewaters and 11 wastewater treatment sludges) samples that were collected by SAIC or facility personnel on behalf of the EPA. All EPA samples were submitted to Agricultural and Priority Pollutants Laboratories, Inc.(APPL) to perform

analyses for volatiles, semivolatiles, metals and general chemistry; and Maxim Technologies, Inc. to perform dioxin analyses. All sample volumes were also obtained in duplicate for the purpose of providing the facilities with sample-splits and the possibility of generating a duplicate data set. Of the twelve facilities sampled, the EPA requested and received split-sample analytical data from six facilities which represented over 50 percent (23 wastewaters and 5 wastewater treatment sludges) of the 52 samples collected. Each of these six facilities either contracted the sample analyses to a commercial laboratory or performed the analysis using an in-house laboratory. A summary of facilities submitting split-sample data and the associated analytical laboratory performing the analysis is provided in Table C-1.

| Table C-1. Facilities Providing Chlorinated Aliphatic Listing Split-Sample Data | | | | |
|--|-----------------|------------------------------------|----------------|--|
| Facility Name | Location | # Split-Sample Data Results | | Analytical Laboratory |
| | | Wastewater | Sludge | |
| Velsicol Chemical Corporation | Memphis, TN | 4 | None Collected | Memphis Environmental Center |
| DuPont-Dow Elastomers | Louisville, KY | 4 | None Collected | Quanterra Environmental Services |
| Borden Chemicals & Plastics | Geismar, LA | 2 | 2 | Gulf Coast Analytical Laboratories, Inc |
| OxyChem | Convent, LA | 1 | 1 | Gulf Coast Analytical Laboratories, Inc |
| Shell Chemical Company | Norco, LA | 4 | 1 | PACE Analytical and Triangle Laboratories, Inc |
| The Dow Chemical Company | Freeport, TX | 8 | 1 | In-House Dow Laboratory |

Data Evaluation And Comparison

Initially, the facility-reported target constituents for each sample were matched directly to the corresponding EPA summarized analytical data. Data summary comparison tables for each facility are included in the Appendix. These comparison tables include only those EPA samples for which facility results were available. The facility results are presented to the right of the corresponding EPA data columns and are designated with a "S" after the sample ID to indicate

split-sample. Only those target analytes that were detected in at least one sample for a given facility are listed according to the analytical method. Constituent concentrations that were present in one data set but were absent or not detected in the other were designated with a “NR” (not reported or the analysis was not performed by the laboratory) or if available the associated laboratory reporting limit.

In an attempt to compare the constituent concentrations reported with the facility split-sample results to the EPA results, the data comparison tables were used to calculate the Relative Percent Difference (% RPD) for instances where both values were reported and were greater than the laboratory reporting limit. The % RPD's were calculated relative to the EPA constituent concentration, therefore, a negative % RPD indicates the facility result is greater than the EPA result, whereas a positive % RPD represents a facility result less than the corresponding EPA result. Since an established data quality objective for split sample or intralaboratory data precision was unavailable, a $\pm 50\%$ RPD was assumed to be reasonable given the interlaboratory precision guideline established in the Quality Assurance Project Plan (QAPjP) was set at 25% RPD.

A total of 373 EPA and facility data sets possessed sample concentrations that could be compared in order to determine the % RPD. For those instances where the % RPD could not be calculated due to one or both values below the laboratory reporting level or listed as “NR”, a “NC” was noted to indicate not calculatable. Of the 373 calculated % RPD's, 257 or 69% were negative while 116 or 31% were positive. This indicates that approximately two-thirds of the facility split data were greater than the corresponding EPA concentration. In addition, 37% of the negative % RPD's were greater than - 50%, in contrast to 22% of the positive % RPD's that were greater than 50%. However, the majority of the % RPD's greater than 50% were attributed to sample concentrations that were either at trace levels or qualified as “J” values indicating the concentrations were below the method detection limit.

Conclusions

Overall, there was good data agreement between the number and types of constituents reported with the EPA and facility split-sample Chlorinated Aliphatics Listing analytical data. The facility split-sample data provide additional confirmation and validity to those constituents that were also reported with the EPA data. Given that data from six separate facility-designated laboratories were compared to data from two EPA laboratories, the precision results as measured by the % RSD are not unreasonable. In addition, there are several possible explanations for constituent concentration results with poor intralaboratory data agreement. These include deviations in sample preparation, digestion, extraction, dilution, as well as analyst technique that may have affected data variability.

Table C-2. Split Sample Comparison Summary

Appendix D. Summary of Waste Generation and Management Practices

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Appendix E. Summary of Chlorinated Aliphatics Manufacturers

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Table E-1. Summary of Chlorinated Aliphatics Manufacturers